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# American River Basin

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### Overview

The fifteen projects in this Proposal together provide a broad array of benefits within the ARB region and externally to the Sacramento-San Joaquin Delta (Delta). While some of these benefits may be quantifiable via economic analyses, many benefits provided by the projects cannot be quantified due to their complex nature. This attachment provides economic analyses of water quality and other benefits expected as a result of implementation of 13 of the 15 projects in this proposal (Project Numbers 5 and 11 do not provide water quality or other benefits). In summary, the projects in this Proposal include the following water quality and other expected benefits:

- Management of groundwater aquifer as a sustainable resource
- Meeting of conjunctive use goals
- Improved recreational opportunities
- Improved educational opportunities
- Flood damage mitigation
- Increased flows in the Delta
- Reduced energy demand and carbon footprint
- Greenhouse gas sequestration
- Reduced wastewater discharges
- Creation of wetland and riparian habitat
- Ecological decomposition of contaminants

## Project 1: City of Roseville ASR Program – Phase 2

### Summary

The Roseville Aquifer Storage and Recovery (ASR) Project is designed to increase water supply reliability through enhancing conjunctive use. The project will install well equipment for two new groundwater extraction wells with surface water injection capabilities in the region near Roseville. These new 1,500 to 2,000 gallon per minute (gpm) groundwater wells will be additions to the city's current groundwater and ASR program. The two wells will be used to inject 480 acre-feet per year (AFY) in the wet months of nearly all year types, and extract 1,920 AFY during dry periods. The project is being administered by the City of Roseville.

The City of Roseville has normally experienced constant growth rates of 4 to 7% per year, which are expected to continue after the current period of economic recession. Other impacts on water demand have included fluctuations in surface and groundwater supplies, increasing concern for environmental impacts, and ongoing and potential impacts to surface water quality and groundwater quality. Current demand is 31,000 AFY (2009) and is estimated to increase to 62,194 AFY at buildout in 2030. Of this 62,194 at buildout, 4,388 AFY would be from recycled water, and 57,806 AFY will be needed from potable supplies. In normal/wet years, pursuant to the Water Forum Agreement, the City can access 58,900 AFY from surface sources. In dry years, surface water supplies cut back to 39,800 AFY, resulting in a shortfall of 19,100 AFY. This shortfall is made up by a planned 20% short-term reduction in demand (11,561 AFY) with the rest coming from groundwater (6,445 AFY). Increases in aquifer storage and recovery capabilities will allow the City to move closer to securing a reliable water supply for its customers now and in the future.

The City's fledgling ASR program, piloted in 2004 with the completion of the Diamond Creek Well, allows injection of surface water from Folsom Lake into the groundwater basin under Placer County. During the winter months (a period of low demand and excess surface water), water is injected and stored until it is needed during the summer months (a period of high demand). The new wells will allow for changes in the timing of the delivery of about 1,920 acre-feet per year (AFY) of surface water in dry years. This project will provide a layer of supply reliability and protection against potential shortfalls, as well as alleviate pressures on surface water supplies in the summer.

A summary of all benefits and costs of the project are provided in Table 1. Water quality and other benefits are discussed in the remainder of this attachment.

**Table 1: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$3.8 million
<u>Monetized Benefits</u>	
Water Supply Benefits	
Avoided Purchased Water Costs (\$400/AF)	\$2.6 million
Total Monetized Benefits	\$2.6 million
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Improved operational flexibility for City of Roseville	++
Increased water supply reliability for customers	+
Water Quality and Other Benefits	
Manage the groundwater aquifer as a sustainable resource	++
Meet regional conjunctive use goals	+
O&M = Operations and Maintenance	
* Direction and magnitude of effect on net benefits:	
+ = Likely to increase net benefits relative to quantified estimates.	
++ = Likely to increase net benefits significantly.	
– = Likely to decrease benefits.	
– – = Likely to decrease net benefits significantly.	
U = Uncertain, could be + or –.	

## The “Without Project” Baseline

In California, as in many other western states, water is often limited during times of greatest demand and is in ample supply during times of lowest demand. One solution to this dilemma, as proposed in this project, is through underground water storage or banking for later use. Without this project, the City would continue to rely on surface water for their primary supplies and use groundwater wells for back up and emergency drought supplies. As demands on surface water supplies continue to increase, the City would fully utilize its surface water allocation from the American River and be forced to use its groundwater wells more intensively. Groundwater levels would drop, and flows in the American River would continue to be low in the dry months, putting pressure on the Sacramento-San Joaquin Delta (Delta) system.

## Water Quality and Other Benefits

The primary benefit of this project is to improve reliability of water supplies. It is not expected to have any impact on the quality of those water supplies. However, the project is expected to bring greater sustainability to the groundwater aquifer, as well as contribute to regional goals of improving flows to the Delta area during dry period.

### Manage the groundwater aquifer as a sustainable resource

The City's ASR program has been developed to improve the City's water supply reliability, maintain groundwater as a sustainable resource, and meet regional conjunctive use program goals. Groundwater management objectives have incorporated goals set by both the *Water Forum Agreement* and the Regional Water Master Plan. In the *Water Forum Agreement*, meeting the water supply availability and reliability needs of Placer County and Sacramento County while protecting the environmental values of the lower American River are deemed co-equal objectives. The ASR program, by the ongoing recharge of groundwater supplies and conjunctive use of water types, contributes to improving sustainable conditions for the aquifer and the lower American River.

### Meet regional conjunctive use goals

The ASR program is an element of a comprehensive, regional conjunctive use program being implemented in southern Placer County and northern Sacramento County. The regional conjunctive use program provides opportunities to reduce stress on the Sacramento-San Joaquin Delta system during dry periods, increasing surface flows through seasonal groundwater banking and surface water exchange.

### Distribution of Project Benefits

The largest beneficiary of benefits from this project will be the City of Roseville and its water customers through improved water supply reliability. Another beneficiary would be Placer County (a regional beneficiary) through the avoidance of potentially negative impacts on the groundwater basin water levels. Also, other communities that rely on surface water for primary supplies in the summer months will benefit from reduced pressure on those supplies. A summary of key project beneficiaries is provided in Table 2.

**Table 2: Project Beneficiaries Summary**

Local	Regional	Statewide
Water Customers of Roseville	Placer County Water Agency service area customers	Lower American River Basin and the Delta

### Project Benefits Timeline Description

It is expected that this project will become operational in 2013 and have a life of 50 years. Project benefits will begin accruing in 2013, when operation begins.

### Potential Adverse Effects from the Project

This project is proposing to inject surface water in times of excess supply and off peak-times; therefore, the project should have negligible negative effects on surface water supplies for environmental purposes. ASR programs hold potential for introducing foreign contaminants found in surface water bodies into groundwater systems and impacting the basin and users of the basin. However, with proper monitoring, institutional controls, and treatment this threat is marginal.

## Summary of Findings

The proposed ASR Project will provide improved management of the groundwater aquifer as a sustainable resource, and reduce low-flow stress in an important delta area, in compliance with regional conjunctive use goals. These are qualitative benefits that have not been monetized.

## Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. These uncertainties are addressed below in Table 3.

**Table 3: Omissions, Biases, and Uncertainties, and Their Effect on the Project**

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Manage the groundwater aquifer as a sustainable resource	+	Sustainable management is an ongoing effort that entails some uncertainties. The feasibility of ASR wells in the Roseville system has been determined by testing at the outset of the program.
Meet regional conjunctive use goals	+	Regional management of the lower basin of the American River, and the Sacramento-San Joaquin Delta, will continue to be an iterative process and may require adjustments during the life of this project.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

## Project 2: Secret Ravine Fish Passage Improvement Project

### Summary

The City of Roseville, in conjunction with Dry Creek Conservancy, proposes to improve fish passage on Secret Ravine in western Placer County, California. Secret Ravine is a perennial stream that supports spawning, juvenile rearing and emigration of Central Valley fall run Chinook salmon (*Oncorhynchus tshawytscha*, a federal species of concern) and spawning, seasonal rearing and migration of Central Valley ESU steelhead (*Oncorhynchus mykiss*, federally listed as a threatened species). An abandoned bridge and utility crossing on Secret Ravine presents a migration obstacle to all species of salmonids. The Secret Ravine Fish Passage Improvement Project proposes to remove the abandoned bridge and modify the channel bed to improve fish passage under all expected flow conditions, enabling salmon to gain access to 10 additional river miles of good spawning habitat.

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The project restores natural channel and floodplain function and increases channel capacity by removing a bridge and pipelines, re-contouring stream banks, and adding nature-mimicking log and boulder structures. The resulting channel shape will provide for overbank flows that will flood adjacent open space areas and relieve flooding of more-constricted developed areas. The restored channel will also reduce erosion of banks and substrate as well as in the adjacent floodplain, thus decreasing sediment transportation. Removal of the bridge sill and pipelines will provide free passage for salmonids inhabiting the creek. The project includes trail improvements that will encourage users to visit the project and observe fish migration and spawning. Interpretive signs will inform visitors about the salmon life cycle and the importance of good watershed practices to preserve habitat for salmonids and other aquatic and riparian species, as well as historical Native American resource use.

## Summary of Costs and Benefits

A summary of the benefits and costs for the project is provided in Table 4. Total present value costs for this project are \$394,477 and are illustrated in Table 5.

There are no water supply benefits associated with this project. Water Quality and other benefits of this project include significant increases in salmonid habitat, flood mitigation, and recreation. Monetized benefits using a transfer of results from stated preference methods range from \$332,000 to over \$9 million in present value. Overall, it appears very likely that the present value benefits of this project outweigh the present value costs.

**Table 4: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$394,477
<u>Monetized Benefits</u>	
Water Quality and Other Benefits	
Salmon Habitat	\$403,754
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Expanded and Enhanced Salmon Habitat	++
Flood Damage Mitigation	+
Enhanced Recreation	+
O&M = Operations and Maintenance * Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. – = Likely to decrease benefits. – – = Likely to decrease net benefits significantly. U = Uncertain, could be + or –.	

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**Table 5: Annual Cost of Project**  
(All costs in 2009 Dollars)  
Project: Secret Ravine Fish Passage Improvement Project

	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	\$0		\$0				\$0	1.00	\$0
2010	\$0		\$0				\$0	0.94	
2011	\$435,824		\$0				\$435,824	0.89	\$387,882
2012	\$0		\$3,958				\$3,958	0.84	\$3,323
2013	\$0		\$398				\$398	0.79	\$315
2014	\$0		\$3,958				\$3,958	0.75	\$2,957
...									
Project Life	50 years							...	
Total Present Value of Discounted Costs (Sum of Column (i))									<b>\$394,477</b>

## The “Without Project” Baseline

Without Secret Ravine Fish Passage Improvement Project, fall run Chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley ESU steelhead (*Oncorhynchus mykiss*) – both special status species -- will be prevented from spawning, and seasonal rearing and migration habitat by an abandoned bridge and utility crossing on Secret Ravine Creek. The obstacles will continue to block salmonid access to approximately 10 miles of spawning habitat above the bridge. No improvement to recreation and educational activities will occur and periodic flooding would continue to damage local residences.

## Water Quality and Other Benefits

The Secret Ravine Fish Passage Improvement Project will remove obstacles and improve habitat for 250 linear feet of Secret Ravine Creek. This improvement will also allow salmonid to access about 10 miles of additional spawning habitat above the project. Historically, estimated Chinook runs of 600 for Secret Ravine for 1963. Similar counts were found in 1965 by the California Department of Fish and Game (DFG). Fall salmon spawning surveys were conducted in the fall of 1963 and 1964 on Secret Ravine. The estimated salmon spawning in 1963 was 300 and twice that, 600-800, in 1964. The report mentions steelheads migrate every fall, but no catch data were recorded. Fish counts have been performed for the past four years with observations of 67 live salmon and 13 carcasses.

There are currently no studies to provide exactly the information that is needed for making management decisions based on monetized benefit values per fish. Various studies of willingness to pay by residents, travel cost surveys, and options values can be used to develop economic valuation estimates. While existing studies often have limitations, they do provide reference points for comparison. For example, in the 1990 University of California Press publication *The Struggle to Restore an Imperiled Resource* (Lufkin, 1990), Alan Lufkin surveys the literature to develop a salmonid value range based on all valuation techniques. Lufkin found that the sport fishing nonmarket economic value (in 1990 dollars) of \$675 per California Salmon or Steelhead in the Sacramento/San Joaquin watershed provided what he deemed to be a fair representation of the value to California residents for each Chinook or steelhead in this region. This amounts to \$1,107 in 2009 dollars, based on the Consumer Price Index. Lufkin states, “Although the economic evaluation of California salmonids should not be expected to produce a complete accounting of the values Californians associate with these fishes, dollar value estimates nonetheless play an important role in determining salmon and steelhead futures.”

Assuming this project increases Chinook salmon runs to the pre-1965 levels of 600 to 800 from the current level of less than 100, using Lufkin’s nonmarket value we can assign a non-market sportfishing value to increasing salmon in the Secret Ravine Creek by multiplying the expected change in Chinook numbers ( $500 = 600 - 100$ ), and multiplying by the estimated value per fish (\$1,107 in 2009 dollars) to arrive at a value of over \$553,000 per year of having an additional 500 Chinook salmon in the creek. This provides a discounted project benefit of about \$7.8 million over the 50 year project life.

It is unclear that this project alone will restore Chinook numbers in Secret Ravine Creek to 1960 levels. However, we can use this valuation to identify the increase in the number of fish that would need to occur for this project to create benefits equal to costs. Using a 50 year project life, Chinook salmon numbers

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would need to increase by 29 – and no other benefits need occur – for this project to have a discounted benefit of about \$404,000, which would more than cover the present value costs. This example calculation is illustrated in Table 6. This reflects about a 30% increase in salmon numbers in this stretch, compared to the census results over the past several years. Using the Lufkin economic valuation the present value benefit of increasing Chinook Salmon in Secret Ravine Creek ranges from about \$404,000, for an increase of 29 salmon per year, to nearly \$7.8 million if populations return to historical levels of 600 or more. Similar calculations performed for changes in Steelhead populations would illustrate the great benefit of increasing Steelhead populations; however, due to a lack of population data, this benefit was not monetized.

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**Table 6: Water Quality and Other Expected Benefits**  
(All benefits in 2009 Dollars)  
**Project: Secret Ravine Fish Passage Improvement Project**

YEAR	Willingness to Pay per Salmon			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units	\$/unit	Value (a)*(b)	# units	\$/unit	Value (d)*(e)	# units	\$/unit	Value (g)*(h)	Total Benefits (c+f+i...)	Discount Factor	Discounted Benefits (j÷k)
2009			\$0			\$0			\$0	\$0	1.00	\$0
2010			\$0			\$0			\$0	\$0	0.94	\$0
2011			\$0			\$0			\$0	\$0	0.89	\$0
2012	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.84	\$24,166
2013	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.79	\$22,798
2014	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.75	\$21,508
2015	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.70	\$20,290
2016	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.67	\$19,142
2017	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.63	\$18,058
2018	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.59	\$17,036
2019	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.56	\$16,072
2020	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.53	\$15,162
2021	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.50	\$14,304
2022	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.47	\$13,494
2023	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.44	\$12,730
2024	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.42	\$12,010
2025	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.39	\$11,330
2026	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.37	\$10,689
2027	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.35	\$10,084

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**Table 6: Water Quality and Other Expected Benefits**  
(All benefits in 2009 Dollars)  
**Project: Secret Ravine Fish Passage Improvement Project**

YEAR	Willingness to Pay per Salmon			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units	\$/unit	Value (a)*(b)	# units	\$/unit	Value (d)*(e)	# units	\$/unit	Value (g)*(h)	Total Benefits (c+f+i...)	Discount Factor	Discounted Benefits (j÷k)
2028	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.33	\$9,513
2029	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.31	\$8,974
2030	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.29	\$8,466
2031	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.28	\$7,987
2032	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.26	\$7,535
2033	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.25	\$7,109
2034	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.23	\$6,706
2035	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.22	\$6,327
2036	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.21	\$5,968
2037	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.20	\$5,631
2038	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.18	\$5,312
2039	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.17	\$5,011
2040	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.16	\$4,728
2041	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.15	\$4,460
2042	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.15	\$4,208
2043	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.14	\$3,969
2044	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.13	\$3,745
2045	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.12	\$3,533
2046	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.12	\$3,333

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**Table 6: Water Quality and Other Expected Benefits**  
(All benefits in 2009 Dollars)  
**Project: Secret Ravine Fish Passage Improvement Project**

YEAR	Willingness to Pay per Salmon			Benefit b			Benefit c			Total Benefits	Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	# units	\$/unit	Value (a)*(b)	# units	\$/unit	Value (d)*(e)	# units	\$/unit	Value (g)*(h)	Total Benefits (c+f+i...)	Discount Factor	Discounted Benefits (j÷k)
2047	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.11	\$3,144
2048	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.10	\$2,966
2049	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.10	\$2,798
2050	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.09	\$2,640
2051	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.09	\$2,490
2052	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.08	\$2,349
2053	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.08	\$2,216
2054	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.07	\$2,091
2055	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.07	\$1,973
2056	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.06	\$1,861
2057	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.06	\$1,756
2058	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.06	\$1,656
2059	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.05	\$1,563
2060	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.05	\$1,474
2061	26.0	\$1,107.00	\$28,782			\$0			\$0	\$28,782	0.05	\$1,391
2092			\$0			\$0			\$0	\$0	0.00	\$0
Total Present Value of Discounted Benefits (Sum of Column (l))												<b>\$403,754</b>

### **Flood Control Benefits**

The Secret Ravine Fish Passage Improvement Project will change the shape of the Secret Ravine Creek channel, restoring the natural channel and floodplain function and increasing channel capacity. The resulting channel path will provide for overbank flows that will flood adjacent open space areas and relieve flooding of more constricted developed areas. The restored channel will also reduce erosion of banks and substrate and in the adjacent flood plain, thus decreasing sediment transport. These flood control benefits are not quantitatively estimable and are therefore mentioned here, qualitatively, rather than in Attachment 9.

### **Recreation**

The Secret Ravine Fish Passage Improvement Project includes trail improvements that will encourage users to visit the project and observe fish migration and spawning. Interpretive signs will inform visitors about the salmon life cycle and the importance of good watershed practices to preserve habitat for salmonid and other aquatic and riparian species, as well as historical Native American resource use.

A new 0.3-mile stretch of granite trail and one new viewing area will be constructed as part of the project, and one new access point will be created. The site is immediately adjacent to the City of Roseville's Miner's Ravine Bike Trail, a heavily-traveled trail used by bicyclists and pedestrians. There is currently a "desire line" indicating the public demand for a trail at this location.

### **Distribution of Project Benefits**

This project will provide benefits to the City of Roseville, including increases in visitor days for fishing and recreation, with associated expenditures, as well as downstream benefits to Placer County and the Delta due to increases in salmonid populations.

**Table 7: Project Beneficiaries Summary**

Local	Regional	Statewide
City of Roseville and residents who value salmon and restored habitat	Placer County	Delta

### **Project Benefits Timeline Description**

This project will have benefits accruing for 50 years, and perhaps longer.

### **Potential Adverse Effects from the Project**

There are no potential adverse effects associated with this project.

### **Omissions, Biases and Uncertainties**

This analysis of costs and benefits is based on available data and several assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the valuation of increasing salmonid populations.

**Table 8: Omissions, Biases, and Uncertainties, and Their Effect on the Project**

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Salmonid Habitat Increases	U	Economic Valuation techniques for nonmarket values for salmonid species are inexact. However, there is a body of empirical evidence in the economics literature suggesting the public places considerable willingness to pay values on preserving and enhancing special status salmon and their habitat.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

## References

- Lufkin, Alan. 1990. *California's Salmon and Steelhead: The Struggle to Restore and Imperiled Resource*. University of California Press. December 11.
- Meyer Resources, Inc. 1988, *Benefits from Present and Future Salmon and Steelhead Production in California*. April.

## Project 3: E.A. Fairbairn Groundwater Well Project

### Summary

The City of Sacramento grew by over 18% between 2000 and 2009 (California Department of Finance). The City's water supply is heavily dependent on the American and Sacramento Rivers, and just 10-15% is normally supplied by groundwater. Concern has been growing about the impacts of climate change on local water supplies. Climate change impacts already apparent in California include reduction in snow pack (used as seasonal storage for water supply) and more flash flows in the rivers during storm events. There is limited storage capacity on the two rivers, and it is considered unlikely that there will be future increases in surface storage in the state. Regionally, environmental policies have been focusing on maintaining and increasing flows in the Sacramento-San Joaquin Delta (Delta), and the American and Sacramento Rivers are primary feeders into the Delta. The City is increasingly vulnerable to changes (and reductions) in surface water supplies. The E. A. Fairbairn Well Project will provide greater reliability for the City's water supply by reducing reliance on surface waters and increasing the abilities of the City to conjunctively manage their supplies.

**American River Basin**  
**Attachment 8 – Water Quality & Other Expected Benefits**

The Fairbairn Well project will provide a new 2 MGD well and ancillary operational support facilities to support the City of Sacramento's conjunctive use program. The new infrastructure will add water supply quantity and greater reliability to the City's water supplies in driest years, and contribute to more environmentally-protective operations. At present, the City takes about 62,000 AF per year from the American River. In the driest of years, this allocation is 50,000 AF. The new well is part of the City's strategy to contribute to regional water supplies to meet the shortfall in dry and driest years.

In past operations, the City did not actively vary the extraction rate from its existing wells from year to year, but under its conjunctive use program, the City will utilize more groundwater to meet demand in drier years. The City will vary the extraction rate depending on American River hydrologic conditions, and more specifically, the projected unimpaired inflow into Folsom Reservoir from March to November. The well utilization will vary from 100% (2,250 AFY) in dry years to 65% (1,462 AFY) in average years and 15% (337 AFY) in wet years.

A summary of all benefits and costs of the project are provided in Table 9. Project costs and water quality and other benefits are discussed in the remainder of this attachment.

**Table 9: Benefit-Cost Analysis Overview**

	<b>Present Value</b>
<u>Costs</u> – Total Capital and O&M	\$4.3 million
<u>Monetized Benefits</u>	
Water Supply Benefits	
Increased System Reliability	\$17.5 million
Water Quality and Other Benefits	None identified
Total Monetized Benefits	\$17.5 million
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Quality Benefits	
Allows system to voluntarily use groundwater when doing so will contribute to maintaining flows in the American River and the Delta	+
O&M = Operations and Maintenance * Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. – = Likely to decrease benefits. – – = Likely to decrease net benefits significantly. U = Uncertain, could be + or –.	

## Costs

The E.A. Fairbairn Well Project budget includes construction of a 2 MGD groundwater and ancillary facilities at the site of the existing E.A. Fairbairn Water Treatment Plant. This is a stand-alone project. The capital cost is \$1.6M USD. Construction is expected to begin in August 2012, and the project will begin operation in January 2014.

Annual operations and maintenance cost is estimated at \$240,000. Over the 50-year life of the project, the present value cost of capital, O&M and replacement total \$4.3M USD.

## The “Without Project” Baseline

Without this project, the City of Sacramento will continue to rely disproportionately on surface water supplies from the American and Sacramento Rivers. With pressures on those supplies coming from climate change impacts, state environmental policies to sustain flow levels into the Sacramento-San Joaquin Delta, and population growth, the City would find itself increasingly unable to guarantee water deliveries.

## Water Quality and Other Benefits

This project will provide indirect regional and state environmental benefits in contributing to operational flexibility to maintain flow requirements in the American River and the Sacramento-San Joaquin Delta area. This benefit is small but positive, as the City of Sacramento is not reducing its allotment from the American and Sacramento Rivers except during very dry years. However, this project affords the City the flexibility to use groundwater temporarily as a substitute for equivalent volumes of surface water.

## Distribution of Project Benefits

The E.A. Fairbairn Well Project primarily benefits the population served by the City of Sacramento water system, who will have increased reliability in their water supply even as changing conditions create greater vulnerabilities in surface water sources such as the American and Sacramento Rivers (which are the major sources of Sacramento’s water supply). Table 10 identifies the distribution of project benefits. This project will also contribute to regional conjunctive use operations, furthering the program in the Sacramento area to sustain flows in the American River under a variety of hydrologic conditions, and to operational flexibility in meeting future needs to sustain flows into the Sacramento-San Joaquin Delta.

**Table 10: Project Beneficiaries Summary**

Local	Regional	Statewide
City of Sacramento	Regional water purveyors under Water Forum Agreement	Delta

## Project Benefits Timeline Description

The Fairbairn well is expected to give 50 years of service. Benefits will accrue as soon as the well becomes operational in 2014. The quantifiable benefits have been calculated to have an annual value of \$1.4 million per year. Over the life of the project, the present value of total quantifiable benefits is \$17.5

million. These figures form the basis of the present value benefits presented in Table 11 of Attachment 7 for this project. Qualifiable benefits, as discussed above, will also accrue over the life of the project.

## Potential Adverse Effects from the Project

The primary adverse effect from the E.A. Fairbairn Well Project could be the potential contribution to groundwater overdraft resulting from additional groundwater extractions. These effects will be mitigated, however, through the varied use of the well, local in-lieu groundwater banking (e.g. using more surface water in normal and wet years; switching to groundwater in dry years), and through local groundwater basin management under the Central Sacramento County Groundwater Management Plan.

## Summary of Findings, Tables

The E.A. Fairbairn Well Project is intended to provide greater reliability to the City of Sacramento's water supply. Approximately 85% to 90% of the City's water supply is from surface water sources; these sources are becoming increasingly vulnerable to the impacts of climate change, through the reduction in the snowpack that feeds the American and Sacramento Rivers, limited storage on the rivers, and changes in storm hydrology. Given the unlikelihood of building additional surface storage, the City is responding to this vulnerability by increasing potential use of groundwater, both for seasonal use annually as well as for more significant use during dry years. The project is not expected to have quantifiable water quality benefits; however, the project will contribute to the regional conjunctive use program as developed under the Water Forum Agreement for sustaining American River hydrologic resources and to future flexibility in addressing flow requirements in the Sacramento-San Joaquin Delta. These qualitative benefits are summarized in Table 11.

**Table 11: Qualitative Benefits Summary --- Water Quality and Other Benefits**

Benefit	Qualitative Indicator
Allows system to voluntarily use groundwater when doing so will contribute maintain water flow in the American River and the Sacramento-SJ Delta	+

## Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. This project is not designed as an element in the management of the Delta, although it may contribute in a small way over time to that state and regional effort. As this is not a goal of this project, no analysis is included here of omissions, biases, or uncertainties that may affect this.

## References

*State of California, Department of Finance. 2009. E-4 Population Estimates for Cities, Counties and the State, 2001-2009, with 2000 Benchmark. Sacramento, California. As viewed at [http://www.dof.ca.gov/research/demographic/reports/estimates/e-4\\_2001-07/](http://www.dof.ca.gov/research/demographic/reports/estimates/e-4_2001-07/). May*

## Project 4: Shasta Park Reservoir and Well Project

### Summary

The City of Sacramento grew by over 18% between 2000 and 2009 (California Department of Finance). The City's water supply is heavily dependent on the American and Sacramento Rivers, and just 10-15% is normally supplied by groundwater. Concern has been growing about the impacts of climate change on local water supplies. Climate change impacts already apparent in California include reduction in snow pack (used as seasonal storage for water supply) and more flash flows in the rivers during storm events. There is limited storage capacity on the two rivers, and it is considered unlikely that there will be future increases in surface storage in the state. Regionally, environmental policies have been focusing on maintaining and increasing flows in the Sacramento-San Joaquin Delta (Delta), and the American and Sacramento Rivers are primary feeders into the Delta. The City is increasingly vulnerable to changes (and reductions) in surface water supplies. The Shasta Park Reservoir and Well Project will provide greater reliability for the City's water supply by reducing reliance on surface waters and increasing the abilities of the City to conjunctively manage their supplies.

The Shasta Park Reservoir and Groundwater Well Project consists of a new 2 million gallon per day (MGD) well, a 4 million gallon (MG) reservoir, booster pump station and ancillary operational support facilities to support the City of Sacramento's conjunctive use program. The new infrastructure will add water supply quantity and reliability to the City's water supplies, and contribute to more environmentally-protective operations. The well and reservoir will serve a disadvantaged area of the City by improving water pressure in that area during the summer months. While the water pressure has always met state standards, it has limited economic development. The new supply will also strengthen firefighting capabilities in the area.

At present, the City takes about 62,000 AF per year from the American River. In the driest of years, this allocation is 50,000 AF. The new well is part of the City's strategy to contribute to regional water supplies to meet the shortfall in dry and driest years. In past operations, the City did not actively vary the extraction rate from its existing wells from year to year, but under its conjunctive use program, the City will utilize more groundwater to meet demand in drier years. The City will vary the extraction rate depending on American River hydrologic conditions, and more specifically, the projected unimpaired inflow into Folsom Reservoir from March to November. The well utilization will vary from 100% (2,250 AFY) in dry years, 65% (1,462 AFY) in average years, and 15% (337 AFY) in wet years.

A summary of all benefits and costs of the project are provided in Table 12. Project costs and water quality and other benefits are discussed in the remainder of this attachment.

**Table 12: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$16.3 million
<u>Monetized Benefits</u>	
Water Supply Benefits	
Increased System Reliability	\$17.5 million
Water Quality and Other Benefits	None identified
Total Monetized Benefits	\$17.5 million
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Increased water pressure during summer months in a disadvantaged area of the City.	++
Adds to firefighting capability.	+
Water Quality Benefits	
Allows system to voluntarily use groundwater when doing so will contribute to maintaining flows in the Delta	+
O&M = Operations and Maintenance	
* Direction and magnitude of effect on net benefits:	
+ = Likely to increase net benefits relative to quantified estimates.	
++ = Likely to increase net benefits significantly.	
– = Likely to decrease benefits.	
– – = Likely to decrease net benefits significantly.	
U = Uncertain, could be + or –.	

## Costs

The Shasta Park Reservoir and Well Project budget includes construction of a 2 MGD groundwater well adjacent to the Cosumnes River, a 4MG reservoir, booster pump station, and ancillary facilities to support operations. The project requires a land purchase for all facilities. This is a stand-alone project; the capital cost is \$13.6 million. Annual operations and maintenance cost is estimated at \$397,000. Over the 50-year life of the project, the present value costs of capital, O&M and replacement total \$16.3 million. Construction is expected to begin in August 2012, and the project will begin operation in January 2014.

## The “Without Project” Baseline

Sacramento has historically relied on surface water from the American and Sacramento Rivers for most of its water supply. In dry years, Sacramento’s share from those sources drops up to 30,000 acre-feet. With increasing demand from a growing population, and with potentially less or greater variance in supply due to climate change impacts on the snowpack and snowmelt that supplies these rivers, the City faces a challenge to the reliability of its water supply, particularly during drought. Without this project, the City

of Sacramento will continue to rely disproportionately on surface water supplies from the American and Sacramento Rivers, and have less opportunity to advance its conjunctive use program.

## Water Quality and Other Benefits

This project will provide indirect regional and state environmental benefits in contributing to operational flexibility to maintain flow requirements in the American River and the Sacramento-San Joaquin Delta area. This benefit is small but positive, as the City of Sacramento is not reducing its allotment from the American and Sacramento Rivers, except during very dry years. However, this project affords the City the flexibility to use groundwater temporarily as a substitute for equivalent volumes of surface water.

## Distribution of Project Benefits

This project primarily benefits the population served by the City of Sacramento water system, who will have increased reliability in their water supply even as changing conditions create greater vulnerabilities in surface water sources such as the American and Sacramento Rivers (which are the major sources of Sacramento's water supply). Table 13 identifies the distribution of project benefits. This project will also contribute to regional conjunctive use operations, furthering the program in the Sacramento area to sustain flows in the American River under a variety of hydrologic conditions, and to operational flexibility in meeting future needs to sustain flows into the Sacramento-San Joaquin Delta.

**Table 13: Project Beneficiaries Summary**

Local	Regional	Statewide
City of Sacramento	Regional water purveyors under Water Forum Agreement	Delta

## Project Benefits Timeline Description

The Shasta Park Reservoir and Well Project are expected to give 50 years of service. Benefits will accrue as soon as the well becomes operational in 2014. The benefits have been calculated to have an annual value of \$1.4 million per year. Over the life of the project, the present value of total benefits is \$17.5 million. These figures form the basis of the present value benefits presented in Table 14 of Attachment 7 for this project. Qualifiable benefits, as discussed above, will also accrue over the life of the project.

## Potential Adverse Effects from the Project

The primary adverse effect from the Shasta Park Reservoir and Well Project could be the potential contribution to groundwater overdraft resulting from additional groundwater extractions. These effects will be mitigated, however, through the varied use of the well, local in-lieu groundwater banking (e.g. using more surface water in normal and wet years; switching to groundwater in dry years), and through local groundwater basin management under the Central Sacramento County Groundwater Management Plan.

## Summary of Findings, Tables

The Shasta Park Reservoir and Well project is intended to provide greater reliability to the City of Sacramento's water supply. Approximately 85% to 90% of the City's water supply is from surface water

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Attachment 8 – Water Quality & Other Expected Benefits

sources. These sources may become increasingly vulnerable to the impacts of climate change, through the reduction in the snowpack that feeds the American and Sacramento Rivers, limited storage on the rivers, and changes in storm hydrology. Given the unlikelihood of building additional surface storage, the City is responding to this vulnerability by increasing potential use of groundwater, both for annual seasonal use as well as more significant use during dry years. The project is not expected to have quantifiable water quality benefits; however, the project will contribute to the regional conjunctive use program as developed under the Water Forum Agreement for sustaining American River hydrologic resources and to future flexibility in addressing flow requirements in the Sacramento-San Joaquin Delta. These qualitative benefits are summarized in Table 14.

**Table 14: Qualitative Benefits Summary --- Water Quality and Other Benefits**

Benefit	Qualitative Indicator
Allows system to voluntarily use groundwater when doing so will contribute maintain water flow in the American River and the Sacramento-SJ Delta	+

### Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. This project is not designed as an element in the management of the Delta, although it may contribute in a small way over time to that state and regional effort. As this is not a goal of this project, no analysis is included here of omissions, biases, or uncertainties that may affect this.

### References

*State of California, Department of Finance. 2009. E-4 Population Estimates for Cities, Counties and the State, 2001-2009, with 2000 Benchmark. Sacramento, California. As viewed at [http://www.dof.ca.gov/research/demographic/reports/estimates/e-4\\_2001-07/](http://www.dof.ca.gov/research/demographic/reports/estimates/e-4_2001-07/). May.*

## Project 6: Regional Water Meter Retrofit Acceleration Project

### Summary

The Regional Water Meter Retrofit Acceleration Project will install 840 additional residential meters in the service areas of three of the largest local public water suppliers in the Sacramento region: the City of Sacramento, Sacramento Suburban Water District, and Sacramento County Water Agency. In complying with California Urban Water Conservation Council (CUWCC) Best Management Practices (BMP) and California law, the greater Sacramento Region has made tremendous progress toward metering its water service connections (just over 30% metered in 2001 compared to over 50% metered by the end of 2007). However, there are in excess of 100,000 meters to install in the region by the year 2025, so there are significant opportunities to accelerate the installation of meters to realize water savings well in advance of the 2025 state mandate. The participating agencies have a combined estimated number of installations of about 15,000 in the final year of their programs. This meter installation program will install about 6% of that amount on a significantly accelerated schedule.

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**Attachment 8 – Water Quality & Other Expected Benefits**

The Regional Water Meter Retrofit Acceleration Project will demonstrably improve water management through direct measurement of consumption using meters. In 2004, the CUWCC published the *BMP Cost and Savings Study* confirming that meters, combined with commodity-based water rates (or volumetric pricing on amount used by the customer), are effective in driving consumer behavior to improved water management by reducing their water consumption. The CUWCC estimated 20 percent savings associated with installing meters, which is the basis for the savings calculation in this application.

While the 20% water savings realized by water-using by customers is a key benefit for any conservation program, a program that installs or upgrades meters has the important added benefit of enabling utilities to better manage all of the water within the metered area. This is because additional measures beyond regular volumetric pricing can be instituted to manage extreme dry conditions. For example, agencies can adopt aggressive tiered pricing structures to encourage further savings and track progress during voluntary or mandatory cutback periods. Metering is also a key component in the American Water Works Association (AWWA) Water Audits Loss Control Programs, allowing a utility to better recognize and control water loss in the distribution system. Appreciable water savings may be realized where metering enables a utility to detect an area where there is a significant volume of unaccounted-for water.

An overview of the expected costs and benefits of the program is provided in Table 15.

**Table 15: Benefit-Cost Analysis Overview**

	<b>Present Value</b>
<u>Costs</u> – Total Capital and O&M	\$900,051
<u>Monetized Benefits</u>	
Water Supply Benefits	
Avoided water treatment costs	\$650,104
Avoided wastewater treatment costs	\$39,244
Total Monetized Benefits	\$758,338
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Effectively implement a water loss control program	++
Water Quality and Other Benefits	
Reduced carbon footprint	++
O&M = Operations and Maintenance * Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. – = Likely to decrease benefits. – – = Likely to decrease net benefits significantly. U = Uncertain, could be + or –.	

## Costs

The present value cost of \$900,051, as shown in Table 16, is for purchase and installation of 840 water meters. Total capital expenditures will be \$968,785, with \$486,756 expended in 2011 and \$482,029 expended in 2012.

Costs for maintenance and replacement of meters was included in Table 16. Based on past experience, it was assumed that 5 out every 100 meters installed would require a site visit to inspect faulty readings requiring 1/2 hour of labor at a rate of \$50 per hour, or \$1,050 per year for the 25 year lifetime of the meters. Replacement of electronic parts or meter boxes would be required for 3 out of every 100 meters per year requiring a 1 hour visit at \$50 per hour labor rate plus material fee of \$125 per site. Replacement costs of \$4,410 per year were included in Table 16.

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Attachment 8 – Water Quality & Other Expected Benefits

<b>Table 16: Annual Cost of Project</b> <b>(All costs in 2009 Dollars)</b> <b>Project: Regional Water Meter Retrofit Acceleration Project</b>									
	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	\$0						\$0	1.00	\$0
2010	\$0						\$0	0.94	\$0
2011	\$486,756						\$486,756	0.89	\$433,211
2012	\$482,029			\$1,050	\$4,410		\$487,489	0.84	\$409,305
2013	\$0			\$1,050	\$4,410		\$5,460	0.79	\$4,325
2014	\$0			\$1,050	\$4,410		\$5,460	0.75	\$4,080
2015	\$0			\$1,050	\$4,410		\$5,460	0.70	\$3,849
2016	\$0			\$1,050	\$4,410		\$5,460	0.67	\$3,631
2017	\$0			\$1,050	\$4,410		\$5,460	0.63	\$3,426
2018	\$0			\$1,050	\$4,410		\$5,460	0.59	\$3,232
2019	\$0			\$1,050	\$4,410		\$5,460	0.56	\$3,049
2020	\$0			\$1,050	\$4,410		\$5,460	0.53	\$2,876
2021	\$0			\$1,050	\$4,410		\$5,460	0.50	\$2,713
2022	\$0			\$1,050	\$4,410		\$5,460	0.47	\$2,560
2023	\$0			\$1,050	\$4,410		\$5,460	0.44	\$2,415
2024	\$0			\$1,050	\$4,410		\$5,460	0.42	\$2,278
2025	\$0			\$1,050	\$4,410		\$5,460	0.39	\$2,149

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Attachment 8 – Water Quality & Other Expected Benefits

<b>Table 16: Annual Cost of Project</b> <b>(All costs in 2009 Dollars)</b> <b>Project: Regional Water Meter Retrofit Acceleration Project</b>									
	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2026	\$0			\$1,050	\$4,410		\$5,460	0.37	\$2,028
2027	\$0			\$1,050	\$4,410		\$5,460	0.35	\$1,913
2028	\$0			\$1,050	\$4,410		\$5,460	0.33	\$1,805
2029	\$0			\$1,050	\$4,410		\$5,460	0.31	\$1,702
2030	\$0			\$1,050	\$4,410		\$5,460	0.29	\$1,606
2031	\$0			\$1,050	\$4,410		\$5,460	0.28	\$1,515
2032	\$0			\$1,050	\$4,410		\$5,460	0.26	\$1,429
2033	\$0			\$1,050	\$4,410		\$5,460	0.25	\$1,349
2034	\$0			\$1,050	\$4,410		\$5,460	0.23	\$1,272
2035	\$0			\$1,050	\$4,410		\$5,460	0.22	\$1,200
2036	\$0			\$1,050	\$4,410		\$5,460	0.21	\$1,132
Project Life	25 years							...	
<b>Total Present Value of Discounted Costs (Sum of Column (i))</b>									<b>\$900,051</b>
Comments: Estimated meter replacement rate , 25 years. For maintenance, assumed 5 out every 100 meters installed would require a site visit to inspect faulty readings requiring 1/2 hour at labor rate of \$50 per hour. For replacement, assumed that 3 out of every 100 meters would require replacement of electronic parts or meter boxes assuming 1 hour per visit at \$50 per hour labor rate plus material fee of \$125 per site.									

## The “Without Project” Baseline

The Regional Water Meter Retrofit Acceleration Project is designed to reduce water demand by driving consumer behavior through the direct measurement of water consumption combined with volumetric pricing. The direct relationship between use and cost will encourage water conservation. Without this project, water supply demand will continue to remain 126 AF/year higher than with this project. Without this project, the 840 meters identified in this project would not be installed until 2025. This project would accelerate installation of these meters by 13 years, saving 1,640 AF in the interim and 3,150 AF for the lifetime of meters. Water savings as a result of this project will lead to reduced water and wastewater treatment. Without this project water and wastewater treatment will continue to emit the 32.8 metric tons of CO<sub>2</sub> per year, or 820 metric tons of CO<sub>2</sub> over the 25 year life of this project.

## Water Quality and Other Benefits

The proposed project will provide avoided water and wastewater treatment through reduction of water demand through conservation. Reduced treatment will lead to reducing energy use, carbon footprint and therefore CO<sub>2</sub> emissions.

### Reduced Energy Demands and CO<sub>2</sub> Emissions

By decreasing water demands through conservation, this project will lead to energy savings and a reduced carbon footprint. This project will lower utility energy use by an estimated 82 MWh/year. Over the expected 25 year lifetime of the meters, the savings will be 2,050 MWh. CO<sub>2</sub> emissions would be reduced by 32.8 metric tons per year, or 820 metric tons over the 25 year life of this project.

This number was determined using the following assumptions:

- One kWh is saved in water treatment for each 700 gallons of water conserved, or 465 kWh per acre foot. Since this project will save approximately 126 acre feet per year, 58.6 MWh per year will be saved. Over the expected 25 year lifetime of the meters, the savings will be 1465 MWh.
- One kWh is used for each 700 gallons of wastewater treated. Since only water used within the home is sent to the wastewater treatment plant and assuming that indoor usage is 40% of total, we assume that 0.4 kWh is saved for each 700 gallons conserved. This translates to 186 kWh energy conserved per acre foot conserved, which translates to a saving of 23.4 MWh per year. Over the expected 25 year lifetime of the meters, the savings will be 586 MWh.
- For every kWh/ year saved, annual carbon emissions are reduced by 0.0004 metric tons. Therefore since this project will lower energy usage by 82 MWh/yr, CO<sub>2</sub> emissions would be reduced by 32.8 metric tons per year, or 820 metric tons over the 25 year life of this project.

These energy use savings do not include reduced in-home water heating costs, which can be a significant energy using activity. No monetary value was assigned to these energy use and carbon emissions reductions.

## Distribution of Project Benefits

The benefits for this project will occur in the Sacramento region and impact consumers of the City of Sacramento, Sacramento Suburban Water District, and Sacramento County Water Agency. Additionally decrease water usage will reduce demand on the Sacramento-San Joaquin Delta and will help the State meet its overall per capita water consumption targets as set forth in its 20x2020 Plan.

**Table 17: Project Beneficiaries Summary**

Local	Regional	Statewide
City of Sacramento, Sacramento Suburban Water District, and Sacramento County Water Agency	Sacramento Region	Sacramento-San Joaquin Delta California - water conservation goals

## Project Benefits Timeline Description

The project build-out and capital costs will be incurred in 2011 and 2012. Project benefits will begin to be fully realized in 2013 and will continue for the expect 25 year lifetime of the water meters.

## Potential Adverse Effects from the Project

There is no evidence to suggest that the project will result in any adverse effects in the future. The biggest challenge will occur with customers adjusting to the new rate structure.

## Summary of Findings, Tables

The monetized water supply benefits from the proposed project of \$758,338 (present value) include the avoided costs of potable water treatment and wastewater treatment based on an estimated water conservation saving of 20% following the implementation of volumetric pricing. The estimated present value cost is \$900,051. While monetized benefits are less than the costs, there also are significant benefits that are not quantified in this analysis and which could have a significant impact on these values. These non-quantified benefits include the opportunities offered by meters in gaining accurate customer usage information that can be used in water auditing programs to identify and control water loss in the distribution systems, helping the region and state meet targeted reductions in per capita water use as required under SBx7-7.

Reduction in water demand can also lead to non-quantified benefits of reduced reducing energy usage and therefore reduced CO<sub>2</sub> emissions. Over the expected 25 year lifetime of the meters, the savings will be 2,050 MWh. CO<sub>2</sub> emissions would be reduced by 32.8 metric tons per year, or 820 metric tons over the 25 year life of this project.

## Project 7: Regional Indoor and Outdoor Water Efficiency Project

### Summary

The goal of the Regional Indoor and Outdoor Efficiency Project is to save an estimated 9,615 acre-feet (AF) of water over the life of the program. This program will be managed by the Regional Water Authority of Sacramento and will be implemented within the service areas of participating agencies, including: Carmichael Water District, Citrus Heights Water District, City of Folsom, City of Roseville, City of Sacramento, El Dorado Irrigation District, Orange Vale Water Company, Placer County Water Agency, Sacramento County Water Agency, Sacramento Suburban Water District, San Juan Water District, Cosumnes Resource Conservation District (not an RWA member).

For the Regional Indoor and Outdoor Water Efficiency Project, four separate water conservation components will be implemented as follows:

#### **Interior Conservation Retrofits**

Complete interior water conservation retrofits will be provided to 1,098 households in the Greater Sacramento Area. A portion of the project will target disadvantaged customers as typically, disadvantaged customers do not participate in water conservation rebates and programs. Reasons for this include a greater proportion of rentals, a higher number of multi-family dwelling units, limited ability to finance the required repairs or improvements, and cultural barriers to participating with governmental agencies.

Under this component of the project, interior water use surveys will be conducted in each household selected for implementation. Interior water use surveys will follow recommendations made by the California Urban Water Conservation Council in their Memorandum of Understanding (MOU, CUWCC, June 9, 2010). Following the survey, direct, no-cost installation of indoor efficiency devices will be completed, including low-flow toilets, showerheads, and faucet aerators. In addition, hose-end shut-off valves will be provided for exterior hose bibs. This effort is expected to save 1,735 AF of water over its lifetime.

#### **Exterior Residential Water Use Surveys and Upgrades**

This component of the proposed project will build upon and expand current programs implemented by several purveyors to conserve water used for urban landscaping. Up to 285 exterior water use surveys will be conducted for single-family accounts. Residential exterior water surveys will meet the criteria established by the CUWCC in the 2010 MOU. In addition, incentives (rebates) worth up to \$500 will be offered to customers to upgrade their existing irrigation systems to improve system performance and efficiency. The expected lifetime conservation of this portion of the project is 140 AF of water.

#### **Exterior Large Landscape Water Use Surveys and Upgrades**

The goal of this project component is to reduce outdoor water use for large landscapes by commercial, institutional, and industrial (CII) customers and residential agricultural customers. This component will also build upon and expand current programs offered by several purveyors to conserve water used for

large landscapes by offering up to 76 exterior water use surveys for these high-use accounts. Exterior surveys would meet the criteria established by the CUWCC as described in their 2010 MOU. In addition, incentives (rebates) worth up to \$1,500 will be offered to customers to upgrade their existing irrigation systems to improve system performance and efficiency. The expected lifetime conservation of this portion of the project is 446 AF of water.

### **Landscape Water Use Budgets**

The greater Sacramento region has over 5,600 dedicated landscape meters. The current approach to preparing water budgets is for each agency to independently perform this service. In addition, many of the existing water budgets have not been prepared utilizing the criteria established in the State's current Model Water Efficient Landscape Ordinance. This project component will create up to 404 landscape budgets following the Model Water Efficient Landscape Ordinance, and prepared in a consistent manner utilizing current data and information. In addition to the landscape water use budgets, this project component will educate local water conservation managers on landscape water use and includes funding to provide training on outreach to customers. The water budgets prepared as part of this component will be provided to the water agencies for follow-up; agency staff will provide a service call to assist the property owner in implementing the budget. In addition, if the property owner and agency staff feels that a landscape water use survey is required, the agency will conduct a survey. The expected lifetime conservation of this portion of the project is 7,294 acre-feet of water.

Table 18 provides an overview of the benefits and costs of this project.

**Table 18: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$837,742
<u>Monetized Benefits</u>	
Water Supply Benefits	
Water conservation for disadvantaged customers	\$650,104
Water conserved through residential exterior surveys and upgrades for single-family homes	\$39,244
Water conserved through CII exterior surveys and upgrades for CII accounts	\$125,022
Water conservation through large landscape water use budgets	\$1,740,388
Total Monetized Benefits	\$2,554,758
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Quality and Other Benefits	
Reduced energy use and carbon footprint	++
Public Education	++
O&M = Operations and Maintenance * Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. – = Likely to decrease benefits. – – = Likely to decrease net benefits significantly. U = Uncertain, could be + or –.	

## Costs

The present value costs for this project amount to \$837,742 as shown in Table 19. These project costs cover water surveys, residential retrofits with water conserving devices, residential and CII irrigation system upgrades/rebates, preparation of water budgets for large landscape users, and three workshops to promote irrigation efficiency. There are no annual costs associated with these projects.

Total capital cost for this project is \$1,000,000; \$400,000 is budget for Interior Conservation Retrofits with \$100,000 to be spent in 2011 and \$300,000 in 2012. For the Exterior Residential Water Use Surveys and Upgrades component and the Exterior Large Landscape Water Use Surveys and Upgrades component, \$300,000 is budgeted with \$37,500 to be spent in 2011, \$150,000 in 2012, and \$112,500 in 2013. And finally, for the Landscape Water Use Budgets component, \$300,000 is budgeted with \$37,500 to be spent in 2011, \$150,000 in 2012, and \$112,500 in 2013.

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**Table 19: Annual Cost of Project**

(All costs in 2009 Dollars)

**Project: Regional Indoor and Outdoor Water Efficiency Project**

	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	\$0						\$0	1.00	\$0
2010	\$0						\$0	0.94	\$0
2011	\$175,000						\$175,000	0.89	\$155,749
2012	\$600,000						\$600,000	0.84	\$503,772
2013	\$225,000						\$225,000	0.79	\$178,221
2014	\$0						\$0	0.75	\$0
2015	\$0								
Project Life	25 years								
<b>Total Present Value of Discounted Costs (Sum of Column (i))</b>									<b>\$837,742</b>
Comments: Capital and other initial costs are the sum of all programs. The DAC Interior Conservation Makeovers will be conducted in 2011 and 2012. Urban Water Use Surveys and Incentives, Agricultural Irrigation Water Use Surveys and Incentives, Landscape Water Use Budgets will be conducted in 2011-2013.									

## The “Without Project” Baseline

This project is designed to promote water conservation through implementation of components of Sacramento’s Regional Water Conservation Blueprint. Without this project, over 9,615 AF of water would be wasted through inefficient water use practices. One target of this project is disadvantaged customers who, without financial assistance, either lack the resources or face other constraints that make them less likely to implement water conserving measures. As water becomes more expensive, and more affluent customers address water conservation, a greater financial burden will occur to disadvantaged communities who, without water conservation, will be paying for more and higher-priced water.

This project also addresses residential and CII customers through exterior water use surveys and through the provision of incentives for system upgrades. Without both components (survey and incentives), consumers will either be unaware of possible savings or lack the incentive to make the changes to promote water conservation. The combination of surveys and incentives is needed to both identify the opportunities for savings and to provide the economic incentives to drive implementation of water conserving methods.

Similar to the exterior water use described above, a consistent approach is needed for developing large landscape water use budgets to promote agricultural irrigation efficiency. Without this project component, each agency will continue to independently perform this service, leading to inconsistent adoption of the State’s current Model Water Efficient Landscape Ordinance. And without the budget development, consumers will likely be unaware of possible savings that can be made to promote water conservation and fiscal savings to large water users.

Finally, without this project, water and wastewater treatment will continue to emit 2,532 metric tons of CO<sub>2</sub> over the 25-year life of this project.

## Water Quality and Other Benefits

The proposed project will provide avoided water and wastewater treatment through reduction of water demand resulting from the implementation of conservation measures. Reduced treatment will lead to reduced energy use, carbon footprint and therefore reduced CO<sub>2</sub> emissions. Public education components incorporated into the conservation measures to be implemented under this project will provide additional water conservations benefits.

### Reduced Energy Use and CO<sub>2</sub> Emissions

By decreasing water demands through conservation, this project will lead to energy savings and a reduced carbon footprint. This project will lower utility energy use by an estimated 6,331 MWh over the 25-year life span of this project. CO<sub>2</sub> emissions would be reduced by 2,532 metric tons over the 25-year life of this project, or 101 metric tons/yr. These numbers were determined using the following assumptions:

- One kWh is saved in water treatment for each 700 gallons of water conserved, or 465 kWh per acre-foot of water treated. Since this project will save approximately 9,615 acre-feet of water over the 25-year lifetime of the project, the energy savings will be 5,525 MWh.

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### Attachment 8 – Water Quality & Other Expected Benefits

- One kWh is used for each 700 gallons of wastewater treated. Since only water used within the home is sent to the wastewater treatment plant, wastewater treatment avoidance will only occur with the Interior Water Conservation Retrofit component of this project. Since this component of the project will save approximately 1,735 acre-feet of water over the 25-year lifetime of the project, the energy savings will be 806 MWh
- For every kWh saved, carbon emissions are reduced by 0.0004 metric tons. Therefore, since this project will lower energy usage by a total of 6,331 MWh, CO<sub>2</sub> emissions will be reduced by 2,532 metric tons over the 25-year life of this project, or 101 metric tons/yr.

These energy use savings do not include reduced in-home water heating costs, which can be a significant energy-using activity.

### Public Education

Substantial, but non-quantifiable, benefits will occur through public education, both through formal training opportunities and through participants in the project servings as champions for water conservation. Public education opportunities include:

- Three irrigation efficiency workshops to be offered in Sacramento, Placer and El Dorado Counties, focusing on promoting agricultural irrigation efficiency practices and technology to small agricultural producers in the American River watershed.
- Education imparted to the participants in this project as part of the water use surveys. This information will most likely spread through a variety of informal means. Participants may share the information learned with neighbors, friends, or business associates. Residences or businesses that participate will serve as models that others may copy in order to reduce water bills. Individuals may move or take a new position, thereby leaving current improvements in place, and bring the knowledge with them.

### Distribution of Project Benefits

The benefits of this project will occur in the Sacramento region and impact consumers of RWA member agencies. Table 20 provides a summary of these beneficiaries.

**Table 20: Project Beneficiaries Summary**

Local	Regional	Statewide
Carmichael Water District, Citrus Heights Water District, City of Folsom, City of Roseville, City of Sacramento, El Dorado Irrigation District, Orange Vale Water Company, Placer County Water Agency, Sacramento County Water Agency, Sacramento Suburban Water District and San Juan Water District, Cosumnes Resource Conservation District	Sacramento Region  American River Watershed	Sacramento-San Joaquin Delta  California – water conservation goals  California – reduced energy use and carbon footprint

### Project Benefits Timeline Description

The project build-out and capital costs will be incurred in 2011, 2012 and 2013. Project benefits will begin in 2011 and will continue for the expected 25-year lifetime (although the savings value of some components will decrease with time, as reflected in the benefits estimates for those components).

### Potential Adverse Effects from the Project

There is no evidence to suggest that the project will result in any adverse effects in the future.

### Summary of Findings, Tables

The monetized water supply benefits from the proposed project have a present value of \$2.55 million. They include the avoided costs of potable water treatment and wastewater treatment based on water conservation. The estimated present value cost is \$837,742

The benefit to cost ratio is 3.0. Several additional benefits are not quantified in this analysis and could have a significant impact on these values. These non-quantified benefits include reducing the carbon footprint of the water and wastewater treatment facilities and improved public education.

### Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In most cases, omissions lead to a downward bias in benefits: the project is expected to be much more beneficial than the subset of benefits that can be monetized would indicate. These issues are listed in Table 21.

**Table 21: Omissions, Biases, and Uncertainties, and Their Effect on the Project**

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Project Costs	U	The calculation of the present value of costs is a function of the timing of capital outlays and a number of other factors and conditions. Changes in these variables will change the estimate of costs.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

## References

California Urban Water Conservation Council. 2010. *Memorandum of Understanding Regarding Urban Water Conservation in California*. June 9.

## Project 8: Sacramento Regional County Sanitation District / Sacramento Power Authority Recycled Water Project

### Summary

Between 2000 and 2009, the population of Sacramento County increased by 14.5%. Population pressures on traditional surface and ground water supplies have prodded many water providers to seek alternative sources; one of these is recycled water, which has been successfully used in California for a century. Recycled water has become an increasingly important water supply source for irrigation of agricultural crops and landscapes, industrial uses such as cooling towers at thermal generation plants, and habitat restoration/protection.

The Sacramento Regional County Sanitation District (SRCSD) initiated efforts in the late 1980's to explore the possibility of using recycled water within their service areas to meet the demands of a growing region, reduce impacts to the community from occasional droughts, and to potentially minimize the imposition of more stringent discharge requirements. SRCSD currently produces secondary and tertiary recycled water at the Sacramento Regional Wastewater Treatment Plant (SRWTP) and its Water Reclamation Facility (WRF), respectively. In 2004, the SRCSD Board of Directors decided to evaluate the possibility of increasing the delivery of recycled water from 5 million gallons per day (MGD) to 30 to 40 MGD over the next 20 years.

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**Attachment 8 – Water Quality & Other Expected Benefits**

The proposed SRCSD/Sacramento Power Authority Recycled Water Project will provide recycled water for the cooling towers of the Campbell Soup Cogeneration Plant, owned by Sacramento Power Authority (SPA). The recycled water will be provided by the existing Water Reclamation Facility and will replace approximately 1,000 acre-feet per year (AFY) or approximately 1 MGD of potable water currently provided by the City of Sacramento. The project will provide design and construction of recycled water transmission facilities and associated modifications to pumping and piping systems. The Sacramento Power Authority is partnering with SRCSD, which will produce the recycled water in its Water Reclamation Facility. The WRF has a current treatment capacity of 5 MGD, and can handle the 1 MGD requirements of the Cogeneration Plant. A future plan will expand the WRF's treatment capacity to 10 MGD.

A summary of all benefits and costs of the project is provided in Table 22. Project costs and water quality benefits are discussed in the remainder of this attachment.

**Table 22: Benefit-Cost Analysis Overview**

	<b>Present Value</b>
<u>Costs</u> – Total Capital and O&M	\$9.4 million
<u>Monetized Benefits</u>	
Water Supply Benefits	
Avoided costs in development of new water supplies	\$4.6 million
Avoided O&M costs of upgraded wastewater treatment	\$3.0 million
Total Monetized Benefits	\$7.6 million
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Increased reliability and local control	++
Reduced groundwater pumping and overdraft	+
Water Quality Benefits	
Reduced groundwater pumping and overdraft	++
Reduced wastewater discharge	+
O&M = Operations and Maintenance	
* Direction and magnitude of effect on net benefits:	
+ = Likely to increase net benefits relative to quantified estimates.	
++ = Likely to increase net benefits significantly.	
– = Likely to decrease benefits.	
– – = Likely to decrease net benefits significantly.	
U = Uncertain, could be + or –.	

## Costs

The capital costs for the project are \$8.4 million, which will cover the pipeline and some piping modifications at the Cogeneration Plant and the WRF. Capital construction is planned for the period between 2013 and 2015; operations will commence in mid-2015. Operation and maintenance costs are \$261,582 per year. The estimated remaining project life for the water reclamation facility (WRF) is 40 years, and for the pipeline is at least 50 years. Over 40 years, the present value total for capital and O&M combined is \$9.4 million (see Attachment 7 for the presentation of present value costs).

## The “Without Project” Baseline

Without this project, the Cogeneration Plant uses 1 MGD (1,000 AFY) of potable water for a purpose that does not require water of such high quality. At the same time, the SRCSD Water Reclamation Facility has uncommitted current capacity which is sufficient to supply recycled water to the Cogeneration plant. In the absence of this project, the City of Sacramento would not have this opportunity to add 1.0 MGD (approximately 1,000 AFY) to its water supply, and would seek to meet growing demand by different means such as higher cost surface water development (if available), groundwater development, leak detection, and/or water conservation programs.

## Water Quality and Other Benefits

### Reduced Groundwater Pumping and Overdraft

Potential benefits of reducing groundwater overdraft are also significant for the environment. These may include the prevention of declines in river and stream flows that are hydrologically connected to the groundwater system. Potential flow reduction can negatively impact the populations of salmon and other native fish species.

Groundwater over-drafting can also result in considerable costs for existing groundwater uses by increasing pumping costs and associated energy use, requiring some relatively shallow wells to be abandoned or deepened, and/or degrading the quality of the extractable waters. Overdrafts can also lead to land subsidence, with associated damages to private and public infrastructure (homes, roads, and so forth).

### Reduced Wastewater Discharge and Improvement in Aquatic Habitat

If potential recycled water is not reused, it would be discharged into the Sacramento River as treated wastewater or effluent. Environmental groups support the recycling program because it reduces the amount of effluent at the outfall, and the resulting water quality improvements in the receiving waters are a benefit to the general public.

For illustrative purposes, the Sacramento River is 303(d) listed for mercury. The NPDES permit limit is 0.01 micrograms per liter for mercury. If the treatment plant discharged at its limit for mercury and approximately 4,500 AFY is used for recycled water, then 55 grams of mercury will be prevented from entering the Sacramento River (and, ultimately, the Delta) each year. Mercury is a toxic element that can be a threat to the health of the public and wildlife. Though depending on its chemical form and the route of exposure, mercury can affect the immune system, alter genetic and enzyme systems, and damage the

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**Attachment 8 – Water Quality & Other Expected Benefits**

nervous system, including coordination and the senses of touch, taste, and sight (USGS, 2006). Reductions in mercury levels (and other contaminants) as a result of the project will have a positive benefit on a riverine system that is already above target concentrations.

Important ecological issues for the Sacramento River Basin are centered around meeting the requirements of the Endangered Species Act, the Central Valley Improvement Act, and the preservation of habitat and biodiversity in aquatic communities. The National Marine Fisheries Service and U. S. Fish and Wildlife Service are required to preserve populations of the endangered winter run Chinook salmon as well as the spring run, which is a species of special concern. The Delta smelt is a threatened species in the Sacramento and San Joaquin Delta that requires specific flows and water quality from the Sacramento and San Joaquin rivers to maintain their population. The Central Valley Improvement Act federally mandates that restoration for four races of Chinook salmon, Steelhead, striped bass, American shad, and white and green sturgeon to levels at least twice the mean estimated natural production for the baseline period (1967-1991) in the San Joaquin and Sacramento rivers, which all requires suitable water quality (USGS, 2006). Additionally, there are less direct aquatic issues that may impact habitat such as maintaining wetlands and rice stubble habitat for waterfowl. These issues all involve water quality, as well as availability, in the river (USGS, 2006).

There have been a number of studies on the value to protect ecological systems and the public's willingness to pay (WTP) to protect riparian and aquatic habitats. Studies have estimated the value of instream flows for protecting threatened and endangered (T&E) fish species. Values ranged from \$7 to \$117 per household for various specific aquatic T&E species (Raucher et al., 2006). A meta-analysis (Loomis and White, 1996) of studies covering 18 different T&E species resulted in similar annual WTP results (\$6 to \$100 per household).

Additionally, improvements in water quality and reduced levels of waste water discharge may help the SCRSD meet waste water discharge standards as they continue to become stricter and remain in compliance with the Clean Water Act and discharge regulations.

### **Distribution of Project Benefits**

Benefits will accrue locally to the City of Sacramento through avoided costs of expanding its water supply portfolio and to regional customers by improving overall system reliability and local control. Beneficiaries of improved water quality will be local, regional, and perhaps statewide.

Table 23 summarizes key project beneficiaries.

**Table 23: Project Beneficiaries Summary**

<b>Local</b>	<b>Regional</b>	<b>Statewide</b>
City of Sacramento	Regional water purveyors under Water Forum Agreement	Delta

## Project Benefits Timeline Description

Infrastructure from this project is expected to last 40 years. Capital construction is anticipated to be completed by 2015. Benefits from the project will begin to accrue upon completion of the project.

## Potential Adverse Effects from the Project

SRCSO will implement appropriate mitigation measures (as identified in the Environmental Impact Report) to ensure that the project does not result in significant impacts.

## Summary of Findings, Tables

The SCRSD/SPA Cogeneration Recycled Water Project will generate monetized benefits from the avoided cost to generate equivalent potable water supply, and also the avoided costs of operational and maintenance wastewater treatment upgrades needed to meet new discharge permit requirements. The amount of water supply created as a result of this project, as well as the avoided cost from this supply creation, was summarized in Table 22.

The project will also generate important local and regional benefits from increased local control, improved supply reliability, and improved water quality through reduced discharges. Though the net present value of costs is significantly larger than monetized benefits, it is important to point out that significant benefits will be derived from improved water supply reliability, general improvements in water quality, and protection of critical aquatic habitats. If the benefit categories were able to be monetized, the monetized value of the project would increase considerably. A qualitative benefits summary is provided in Table 24.

**Table 24: Qualitative Benefits Summary --- Water Quality and Other Benefits**

Benefit	Qualitative Indicator
Reduced groundwater pumping and overdraft	+
Reduced wastewater discharge & improvement in aquatic habitat in Sacramento River and Delta	++

## Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the difficulty in quantifying the likely direct impacts of reduced groundwater pumping on groundwater levels (resulting from the substitution of recycled water for groundwater supply), and the water quality impacts directly attributable to the reductions in wastewater effluent discharges resulting from this project. These issues are listed in Table 25.

**Table 25: Omissions, Biases, and Uncertainties, and Their Effect on the Project**

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Reduced groundwater pumping and overdraft	+	Information on the potential impact of the project on groundwater levels in the area is not known to the authors at this time. However, reducing any level of groundwater pumping from an over drafted system will result in positive benefits.
Improvements in water quality/ Improvement in aquatic habitat as a result of water quality improvements (reduced wastewater discharge)	++	Benefits associated with the improvement in water quality and the resulting improvements in aquatic habitats could not be monetized. There is value for protecting waterways and improving water quality, especially if the water bodies are source water supplies or are areas that are highly used for activities such as recreation or habitat for endangered species. Given the number of people in Sacramento County that would have some WTP for protection of the Sacramento River or Delta region, benefits could be considerable.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

## References

Raucher, R.S., J. Henderson, and J. Rice. 2006 (forthcoming). *An Economic Framework for Evaluating the Benefits and Costs of Water Reuse*. WaterReuse Foundation. Arlington, VA.

USGS, 2006. Sacramento River Basin National Water-Quality Assessment Program. [http://ca.water.usgs.gov/sac\\_nawqa/index.html](http://ca.water.usgs.gov/sac_nawqa/index.html)

Loomis, J.B. and D.S. White, 1996. Economic benefits of rare and endangered species: Summary and meta-analysis. *Ecological Economics* 18:197-206.

## Project 9: North Antelope Booster Pump Station Project

### Summary

The North Antelope Booster Pump Station Project consists of a booster pump station with a design flow of 4,200 gallons per minute (gpm) adjacent to the existing Antelope Reservoir. This pump station will pump groundwater from the Sacramento Suburban Water District's (SSWD) North Service Area eastward into the Antelope and Cooperative Transmission pipelines for conveyance to the various San Juan Water District (SJWD) retail customers. All of these districts, with the exception of SSWD, rely on surface water for the majority of their supply, with the remaining small portion of supply coming from local groundwater wells. This project will provide for the reversal of flow in the Antelope and Cooperative Transmission Pipelines, thereby allowing SSWD to export previously banked groundwater to the other agencies connected to the pipeline.

This project will expand conjunctive use opportunities in the SJWD service area, enabling the retail surface water customers to use more groundwater during dry years and in times of emergency and greatly expanding regional opportunities for conjunctive use. This will be accomplished by extending the service area that can be supplied by groundwater. Expanding the opportunity for conjunctive use will have both regional and statewide benefits during dry years and other times when supplies are limited.

Other benefits of the North Antelope Booster Pump Station Project include sustaining flows in the lower American River during dry years by providing groundwater to surface water users, thereby reducing their demand on the river. In addition, this project will provide a secondary source of supply for retail customers in the San Juan service area in the event that the capacity of the Peterson Surface Water Treatment Plant is limited due to conditions beyond the control of SJWD. In general, having access to an additional source of water increases water supply reliability and protects SJWD customers' limited, local groundwater resources.

### Cost and Benefit Summary

A summary of all benefits and costs for this project are provided in Table 26. Discounted project costs over the 40 year life of the project are \$837,400.

Monetized project benefits include a willingness to pay estimate for water supply reliability for SJWD customers of over \$3.2 million over the 40 year project life. Water supply benefits are covered in Attachment 7.

Water Quality and other benefits include increases in in-stream flow (and attendant benefit to fish and wildlife and ecosystems) due to increase in American River in-stream flows. These benefits are discussed in this attachment.

**Table 26: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$837,400
<u>Monetized Benefits</u>	
Water Supply Benefits	
Increased Water Supply Reliability for SJWD customers	\$3.2 million
Total Monetized Benefits	\$3.2 million
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Improved operational flexibility for SSWD & SJWD	++
Water Quality and Other Benefits	
Allows system to voluntarily use groundwater when doing so will contribute to maintaining flows	++
O&M = Operations and Maintenance	
* Direction and magnitude of effect on net benefits:	
+ = Likely to increase net benefits relative to quantified estimates.	
++ = Likely to increase net benefits significantly.	
– = Likely to decrease benefits.	
– – = Likely to decrease net benefits significantly.	
U = Uncertain, could be + or –.	

## Costs

The primary cost of the project is construction of the Booster Pump. Construction costs of \$918,412, begin with award of the project in November of 2012 and continue with project completion the end of 2013. Operational costs begin in 2014 when construction is completed and will continue for the 40-year project life. Table 27 provides an illustration of costs and the total discounted value for the project.

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**Table 27: Annual Cost of Project**  
(All costs in 2009 Dollars)  
**Project: North Antelope Booster Pump Station Project**

	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	\$0	\$0	\$0	\$0	\$0	\$0	\$0	1.000	\$0
2010	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0.943	\$0
2011	\$41,835	\$0	\$0	\$0	\$0	\$0	\$41,835	0.890	\$37,233
2012	\$113,253	\$0	\$0	\$0	\$0	\$0	\$113,253	0.840	\$95,133
2013	\$763,324	\$900	\$6,300	\$700	\$0	\$0	\$771,224	0.79	\$610,882
2014	\$0	\$900	\$6,300	\$700	\$0	\$0	\$7,900	0.75	\$5,903
2015	\$0	\$900	\$6,300	\$700			\$7,900	0.70	\$5,569
2016	\$0	\$900	\$6,300	\$700			\$7,900	0.67	\$5,254
2017	\$0	\$900	\$6,300	\$700			\$7,900	0.63	\$4,957
2018	\$0	\$900	\$6,300	\$700			\$7,900	0.59	\$4,676
2019	\$0	\$900	\$6,300	\$700			\$7,900	0.56	\$4,411
2020	\$0	\$900	\$6,300	\$700			\$7,900	0.53	\$4,162
2021	\$0	\$900	\$6,300	\$700			\$7,900	0.50	\$3,926
2022	\$0	\$900	\$6,300	\$700			\$7,900	0.47	\$3,704
2023	\$0	\$900	\$6,300	\$700			\$7,900	0.44	\$3,494
2024	\$0	\$900	\$6,300	\$700			\$7,900	0.42	\$3,296
2025	\$0	\$900	\$6,300	\$700			\$7,900	0.39	\$3,110
2026	\$0	\$900	\$6,300	\$700			\$7,900	0.37	\$2,934

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**Table 27: Annual Cost of Project**  
(All costs in 2009 Dollars)  
**Project: North Antelope Booster Pump Station Project**

	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2027	\$0	\$900	\$6,300	\$700			\$7,900	0.35	\$2,768
2028	\$0	\$900	\$6,300	\$700			\$7,900	0.33	\$2,611
2029	\$0	\$900	\$6,300	\$700			\$7,900	0.31	\$2,463
2030	\$0	\$900	\$6,300	\$700			\$7,900	0.29	\$2,324
2031	\$0	\$900	\$6,300	\$700			\$7,900	0.28	\$2,192
2032	\$0	\$900	\$6,300	\$700			\$7,900	0.26	\$2,068
2033	\$0	\$900	\$6,300	\$700			\$7,900	0.25	\$1,951
2034	\$0	\$900	\$6,300	\$700			\$7,900	0.23	\$1,841
2035	\$0	\$900	\$6,300	\$700			\$7,900	0.22	\$1,736
2036	\$0	\$900	\$6,300	\$700			\$7,900	0.21	\$1,638
2037	\$0	\$900	\$6,300	\$700			\$7,900	0.20	\$1,545
2038	\$0	\$900	\$6,300	\$700			\$7,900	0.18	\$1,458
2039	\$0	\$900	\$6,300	\$700			\$7,900	0.17	\$1,375
2040	\$0	\$900	\$6,300	\$700			\$7,900	0.16	\$1,298
2041	\$0	\$900	\$6,300	\$700			\$7,900	0.15	\$1,224
2042	\$0	\$900	\$6,300	\$700			\$7,900	0.15	\$1,155
2043	\$0	\$900	\$6,300	\$700			\$7,900	0.14	\$1,090
2044	\$0	\$900	\$6,300	\$700			\$7,900	0.13	\$1,028

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 27: Annual Cost of Project**  
(All costs in 2009 Dollars)  
**Project: North Antelope Booster Pump Station Project**

	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2045	\$0	\$900	\$6,300	\$700			\$7,900	0.12	\$970
2046	\$0	\$900	\$6,300	\$700			\$7,900	0.12	\$915
2047	\$0	\$900	\$6,300	\$700			\$7,900	0.11	\$863
2048	\$0	\$900	\$6,300	\$700			\$7,900	0.10	\$814
2049	\$0	\$900	\$6,300	\$700			\$7,900	0.10	\$768
2050	\$0	\$900	\$6,300	\$700			\$7,900	0.09	\$725
2051	\$0	\$900	\$6,300	\$700			\$7,900	0.09	\$684
2052	\$0	\$900	\$6,300	\$700			\$7,900	0.08	\$645
2053	\$0	\$900	\$6,300	\$700			\$7,900	0.08	\$608
Project Life	40 years							...	
Total Present Value of Discounted Costs (Sum of Column (i))									\$837,400

## The “Without Project” Baseline

In California and many other western states, surface water is often limited during times of greatest demand and is in relatively ample supply during times of lowest demand. One solution to this dilemma, as proposed in this project, is increasing the flexibility of water delivery. Currently, the SJWD and their retail customers receive the majority of their water from surface waters while SSWD receives the majority of their water from groundwater. This project would allow SSWD to send groundwater to SJWD to use instead of surface water, especially in dry years. This opportunity to provide conjunctive use of groundwater and surface water would allow the two water districts to work together to maximize the beneficial use of available supply under a variety of water year types. In dry years, surface water supplies are limited due to the need to sustain flows in the lower American River, and with completion of this project, groundwater use can be expanded regionally to reduce stress on limited American River supplies.

Without this project, water supplies will be limited for SJWD customers during dry years and benefits to the entire lower American River of shifting to alternative water supply sources will be unavailable. Further, without this project, SJWD customers will be solely reliant upon one source of water and water treatment – and in the event of a catastrophic event to the Peterson water treatment plant, they would have no alternative source for water supplies.

Without this project, all users downstream of this project (including SJWD customers and all Sacramento-San Joaquin Delta water users), as well as in-stream environmental needs for the lower American River, will not have the dry year buffer supplied by this project.

## Water Quality and Other Benefits

This project will provide an indirect state environmental benefit in contributing to operational flexibility to maintain flow requirements in the American River and the Sacramento-San Joaquin Delta (Delta) area. This benefit is small but positive, as the SJWD is not reducing its allotment from the American River, except during very dry years. However, this project affords the SJWD the flexibility to use groundwater temporarily as a substitute for equivalent volumes of surface water.

### Reduced Stress on the Delta

By reducing the use of American River surface water, this project will augment in-stream flows in the Delta, or offset other diversions that may otherwise reduce flows. Reduced demands on Delta supplies will also help reduce the overall salinity of the Delta and improve Delta habitat, especially in dry years.

Maintaining the Delta’s environmental condition is vital to maintaining and improving the viability of the region. The Delta provides drinking water to 25 million people, supports irrigation of 4.5 million acres of agriculture, and serves as a home to 750 plant and animal species. The Delta's 1,600 square miles of marshes, islands and sloughs support at least half of migratory water birds on the Pacific flyway, 80 percent of California's commercial fisheries, and recreational uses including boating, fishing and windsurfing.

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

Delta resources are in a state of crisis. Fish populations including salmon and Delta-smelt have declined dramatically in recent years. The levee system is aging, and vulnerability of the Delta to flooding, sea-level rise, or a major earthquake has contributed to concerns about possible levee collapse. In addition, water quality problems continue, and there is little consensus on how to manage water resources through storage.

### Distribution of Project Benefits

The largest beneficiary of benefits from this project will be the SJWD and its water customers through improved water supply reliability. Other beneficiaries include downstream users of the American River (a regional beneficiary) through the increase in water supply availability due to the lack of withdrawal by SJWD. In-stream users of American River (fish and wildlife habitats, etc) will also benefit by having additional in-stream flows.

**Table 28: Project Beneficiaries Summary**

Local	Regional	Statewide
Water Customers of SJWD	Lower American River	Sacramento-San Joaquin Delta

### Project Benefits Timeline Description

It is expected that this project will become operational in 2014 and have a life of 40 years. Project benefits will begin accruing in 2014, when operation begins.

### Potential Adverse Effects from the Project

There are no potential adverse affects attributable to his project.

### Summary of Findings

Consumers are willing to pay an additional amount to ensure they have adequate water supplies at all times. Utilizing the willingness to pay literature allows us to determine the value to SJWD customers of having an additional source of water that can be used to increase their supply reliability. If SJWD customers have a 5.7% increase in the reliability of their water supply due to this project than they are willing to pay between \$3.2 million or more for this project.

There is a small benefit to downstream users and stakeholders of the American River, as well as the Delta, due to the reduction in surface water extraction by SJWD in dry years.

## Project 10: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project

### Summary

Sacramento Suburban Water District (SSWD) serves a population of about 160,000, and is one of the largest groundwater users in the Sacramento Groundwater Authority (SGA) Groundwater Management Plan (GWMP) area. However, SSWD does rely significantly on purchased surface water supplies to augment its groundwater supplies. In 2008, groundwater supplied 61% (23,500 AF) of SSWD's water supply, with the other 39% (15,000 AF) drawn from surface water. There is some uncertainty as to the guaranteed availability of surface water supplies in the future, as supplies may not be available on the market and as the reliability of surface water becomes uncertain due to future climate changes and regulatory-driven changes in the downstream Sacramento-San Joaquin Delta.

As groundwater levels steadily dropped in the last half of the 1900s, SSWD initiated an in-lieu groundwater recharge program. Starting in 1998, SSWD offset potable use of groundwater with surface water, allowing groundwater that would otherwise be withdrawn to remain 'banked' in the groundwater basin. Since then, SSWD has banked in excess of 150,000 AF. Additionally, SSWD has made significant investments to put surface water supply and conjunctive use facilities in place, allowing it to flexibly manage its supply portfolio to ensure the sustainability of both resources. This infrastructure and regional water resources has placed SSWD in a key position to help support regional conjunctive use efforts in addition to meeting its own needs.

SSWD's Master Plan, prepared in 2009, stated that the North Service Area (NSA) is low on reserve capacity and, due to the age of the existing groundwater infrastructures, additional groundwater sources would be required. Additional groundwater sources will be added in the next five to ten years to provide more reliability to the system as required. The Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project proposes the construction of two new wells with pump and treatment facilities in the SSWD's North Service Area (NSA). The selected locations for the new wells and pump stations are intended to prevent and avoid interactions with regional groundwater contamination plumes near the southern portion of the district. The Coyle Avenue Well will have a pumping capacity of 2,250 acre-feet per year (1,400 gpm), as documented in the *Coyle Avenue Exploration Summary and Well Design Recommendations Technical Memorandum* (Luhdorff and Scalmanini, January 2010) while the Roseview Park Well will have a capacity of 3,500 acre-feet per year (2,200 gpm). These additional extraction facilities, combined with previously banked groundwater, will allow SSWD to increase groundwater use during dry periods, leaving additional surface water in the American River for habitat protection and to meet water quality objectives.

A summary of all benefits and costs of the project are provided in Table 29. Water quality and other benefits are discussed in the remainder of this attachment.

**Table 29: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$6.1M
<u>Monetized Benefits</u>	
Water Supply Benefits	
Increased water supply reliability	\$11.3M
Total Monetized Benefits	\$11.3M
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Conjunctive use in alignment with WFA and regional conjunctive water management objectives.	++
Water Quality and Other Benefits	
Expands water supply and reliability in an area of the district away from a regional groundwater contamination plume.	+
Supports regional objective of maintaining sufficient surface water in American River for habitat protection.	+
O&M = Operations and Maintenance * Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. – = Likely to decrease benefits. – – = Likely to decrease net benefits significantly. U = Uncertain, could be + or –.	

## Costs

Total present value costs for this project are \$6.1 million and are illustrated in Table 30. Total capital costs for this project are \$5,735,537, however, \$72,390 of the total project costs have been incurred in calendar year 2010. Because these are “sunk costs,” they are not used in calculating the net present value of all costs associated with this project.

Construction on the two wells will start in 2011 and be complete by 2012, with a total capital cost of \$5.7 million. With annual O&M costs of \$68,000 and periodic replacement costs, the present value cost is \$6.1 million. Construction at the Coyle Avenue site will begin in early 2011, with will be completed by mid-2012. Construction at the Roseview Park site will begin in mid-2011 and will be completed by late 2012.

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 30: Annual Cost of Project**

(All costs in 2009 Dollars)

**Project: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project**

	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2010	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0.94	\$0
2011	\$1,173,945	\$0	\$0	\$0	\$0	\$0	\$1,173,945	0.89	\$1,044,807
2012	\$4,489,202	\$4,396	\$19,782	\$1,539	\$0	\$0	\$4,514,919	0.84	\$3,790,813
2013	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.79	\$53,972
2014	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.75	\$50,917
2015	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.70	\$48,035
2016	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.67	\$45,316
2017	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.63	\$42,751
2018	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.59	\$40,331
2019	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.56	\$38,048
2020	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.53	\$35,894
2021	\$0	\$7,693	\$54,950	\$5,495	\$175,840	\$0	\$243,978	0.50	\$121,250
2022	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.47	\$31,946
2023	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.44	\$30,138
2024	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.42	\$28,432
2025	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.39	\$26,822
2026	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.37	\$25,304
2027	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.35	\$23,872
2028	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.33	\$22,520

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 30: Annual Cost of Project**

(All costs in 2009 Dollars)

**Project: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project**

	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2029	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.31	\$21,246
2030	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.29	\$20,043
2031	\$0	\$7,693	\$54,950	\$5,495	\$175,840	\$0	\$243,978	0.28	\$67,705
2032	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.26	\$17,838
2033	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.25	\$16,829
2034	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.23	\$15,876
2035	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.22	\$14,977
2036	\$0	\$7,693	\$54,950	\$5,495	\$703,360	\$0	\$771,498	0.21	\$159,984
2037	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.20	\$13,330
2038	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.18	\$12,575
2039	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.17	\$11,864
2040	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.16	\$11,192
2041	\$0	\$7,693	\$54,950	\$5,495	\$175,840	\$0	\$243,978	0.15	\$37,806
2042	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.15	\$9,961
2043	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.14	\$9,397
2044	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.13	\$8,865
2045	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.12	\$8,363
2046	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.12	\$7,890
2047	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.11	\$7,443

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

<b>Table 30: Annual Cost of Project</b> <b>(All costs in 2009 Dollars)</b> <b>Project: Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project</b>									
	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2048	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.10	\$7,022
2049	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.10	\$6,625
2050	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.09	\$6,250
2051	\$0	\$7,693	\$54,950	\$5,495	\$175,840	\$0	\$243,978	0.09	\$21,111
2052	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.08	\$5,562
2053	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.08	\$5,247
2054	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.07	\$4,950
2055	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.07	\$4,670
2056	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.06	\$4,406
2057	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.06	\$4,156
2058	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.06	\$3,921
2059	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.05	\$3,699
2060	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.05	\$3,490
2061	\$0	\$7,693	\$54,950	\$5,495	\$0	\$0	\$68,138	0.05	\$3,292
Project Life	50 years								
<b>Total Present Value of Discounted Costs (Sum of Column (i))</b>									<b>\$6,058,750</b>
Comments: Replacement costs were derived from a comparable ASR project. 50-Year project									

## The “Without Project” Baseline

There are known groundwater contamination plumes in the groundwater basin underlying SSWD. The District has five wells close to these plumes. Several mitigation measures have been identified: tracking monitoring, promoting additional monitoring wells, conducting additional modeling and studies, abandoning or replacing wells, and modifying well pumping.

This project will replace two aging wells closer to the plumes with two others located outside the regional groundwater cone of depression, away from the plumes. The old wells will be retired. Without this project, the District would continue to rely on the aging wells and make use of other mitigation measures such as those listed above.

## Water Quality and Other Benefits

Although no water quality or other non-supply benefits have been monetized, several significant benefits have been identified. These include a transfer of groundwater extraction capacity from an area affected by groundwater contamination plumes, and enhancement of SSWD’s capacity to contribute to regional objectives of maintaining sustainable water flows for habitat protection in the American River.

### **Expands water supply and reliability in an area of the district away from a regional groundwater contamination plume**

As noted above, there are several groundwater contamination plumes within and close to the District’s service area. These plumes contain perchlorate, N-Nitrosodimethylamine (NDMA), and various organic compounds. The siting of the two wells in this project will replace wells closer to these plumes with wells much farther north.

### **Supports regional objective of sustainable flows in American River for habitat protection**

By strengthening SSWD’s capacity to extract groundwater banked via in-lieu means during wet periods, there will be more groundwater supplies during dry periods and less stress on surface supplies in the American River. SSWD hopes to be able to use this capacity to support other water districts in the region facing a shortfall in dry years due to reductions in surface supplies. Regionally, this supports the goal of maintaining sustainable flows in the river for habitat protection.

## Distribution of Project Benefits

Beneficiaries of this project include the population served by SSWD who will be served by a water supply better protected from groundwater contamination, and the regional population who will be supporting sustainable habitat protection in the American River. Table 31 summarizes project beneficiaries.

**Table 31: Project Beneficiaries Summary**

Local	Regional	Statewide
Population served by SSWD	Regional stakeholders for conjunctive use programs and American River habitat protection	Reduced pressure on surface supplies that ultimately impact the Delta

## Project Benefits Timeline Description

The project's water quality benefits will begin immediately upon the two wells going into operation in 2012. These benefits are not monetized.

## Potential Adverse Effects from the Project

The primary adverse effect from the project is the potential contribution to groundwater overdraft resulting from additional groundwater extractions. These effects will be mitigated, however, through the varied use of the well, local in-lieu groundwater banking (e.g. using more surface water in normal and wet years; switching to groundwater in dry years), and through local groundwater basin management under the Sacramento Groundwater Authority Groundwater Management Plan.

## Summary of Findings, Tables

The primary benefit of this project is to improve water supply reliability and meet the service area's current and projected future demand. The two wells will replace aging wells, improving capacity to extract banked groundwater for use during dry periods. The water quality benefits are secondary, but includes reduced likelihood of exposure to regional groundwater contamination plumes, and enhanced capacity to maintain sustainable flows in the American River to support goals for habitat protection. These benefits are summarized in Table 32.

**Table 32: Qualitative Benefits Summary – Water Quality and Other Benefits**

Benefit	Qualitative Indicator
Expands water supply and reliability in an area of the district away from a regional groundwater contamination plume	+
Supports regional objective of sustainable flows in American River for habitat protection	+

## Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the extent to which this project contributes to mitigating risks posed by the regional groundwater contamination plumes, and the extent to which this project contributes to better habitat protection in the American River. These issues are listed in Table 33.

**Table 33: Omissions, Biases, and Uncertainties, and Their Effect on the Project**

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Mitigation of risks associated with regional groundwater contamination plumes	+	
Contributes to habitat protection on American River	+	
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

## References

Luhdorff and Scalmanini. 2010. *Coyle Avenue Exploration Summary and Well Design Recommendations Technical Memorandum*. January.

## Project 12: Lower American River Mile 0.5 Aquatic Riparian Habitat Enhancement

### Summary

The Aquatic and Riparian Habitat Enhancement in the Lower American River (LAR) at River Mile 0.5R Project focuses on lowering and re-grading the over-steepened river bank at LAR mile 0.5R and providing improved riparian habitat for fish, birds, and other species along the lower end of the American River. The project is located in the American River Parkway (Parkway) along the north (or right) bank of the American River, one-half mile upstream of the confluence with the Sacramento River.

The Aquatic and Riparian Habitat Enhancement in the Lower American River (LAR) at River Mile 0.5R Project will be implemented over two construction seasons in the same year. The first phase would involve transplanting existing elderberry shrubs from 2.5 acres identified as floodplain habitat onto approximately five acres of upland that is currently populated by non-native weedy grasses and reseeding for erosion control. The second phase would involve degrading the existing bank at River Mile 0.5R (RM 0.5R), grading benches at various elevations, installing erosion control structures and woody material on the constructed benches and planting native grasses, tules, shrubs and trees on the benches and on the adjacent elevated floodplain.

## Summary of Costs and Benefits

A summary of the benefits and costs for the project is provided in Table 34. Total present value costs for this project are \$1,992,876 and are illustrated in Table 35.

The majority of costs associated with this project (approximately 63%) are for implementation, but a project contingency is required (some 13% of project costs) and a smaller portion of the project budget is allocated for direct project administration, land/easement purchase, planning, environmental compliance, and construction administration. The project costs are spread out over an implementation period between 2010 and January of 2014; however, the majority (some 86%) of all project costs will occur during Phase 1 of project construction/implementation, scheduled to occur in January and February 2013, and Phase 2 of project construction/implementation, scheduled to occur from July through November of 2013. \$161,153 of the total project costs have been incurred by calendar year 2010. Because these are “sunk costs,” they are not used in calculating the net present value of all costs associated with this project.

**Table 34: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$1.99 million
<u>Monetized Benefits</u>	
None Identified	
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Groundwater Recharge	+
Water Quality Benefits	
Ecological Decomposition of Contaminants	++
Other Benefits	
Provide Wetland & Riparian Habitat for Species	++
Improved Recreational Opportunities	++
Improved Educational Opportunities	+
O&M = Operations and Maintenance	
* Direction and magnitude of effect on net benefits:	
+ = Likely to increase net benefits relative to quantified estimates.	
++ = Likely to increase net benefits significantly.	
– = Likely to decrease benefits.	
– – = Likely to decrease net benefits significantly.	
U = Uncertain, could be + or –.	

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 35: Annual Cost of Project**

(All costs in 2009 Dollars)

**Project: Lower American River Mile 0.5 Aquatic Riparian Habitat Enhancement**

	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	\$0						\$0	1.000	\$0
2010	\$0						\$0	0.943	\$0
2011	\$26,859						\$26,859	0.890	\$23,905
2012	\$26,859						\$26,859	0.840	\$22,562
2013	\$2,309,865						\$2,309,865	0.792	\$1,829,413
2014	\$80,577						\$80,577	0.747	\$60,191
2015	\$80,576						\$80,576	0.705	\$56,806
Project Life	50 years								
<b>Total Present Value of Discounted Costs (Sum of Column (i))</b>									<b>\$1,992,876</b>
Comments: \$161,153 of the total project costs from table 7 have been incurred in calendar year 2010. Because these are "sunk costs," they are not included in this table or used in calculating the net present value of all costs associated with this project.									

## The “Without Project” Baseline

The lower American River corridor has been highly altered by human activities including hydraulic mining, dredging, dam building and levee construction. These activities have led to massive amounts of sediment being washed into the river, transported downstream, and deposited near the river mouth, where it significantly raised the bottom of the channel. When these human disturbances ended, the river gradually began to cut through the deposited material, steadily lowering the channel bottom until the river hit a geologically stable level. The channel is now beginning to expand laterally through erosion of the sediment deposited along the banks of the lower river, which steepens the bank, undermines its stability, and leads to potential mass failure under high velocity river flows. As a result of this process, the floodplain is on a high terrace that is not inundated during routine winter flooding events that are critical for young native fish like salmon and steelhead. Water-loving riparian vegetation survives on the terraces, but new trees are not surviving because of the distance to water. The state of habitat for a number of special status species in this stretch of the American River is impoverished. Without this project, this situation is expected to continue.

## Water Supply Benefits

### Groundwater Recharge

Widening the inundated area at mile 0.5 of the lower American River should increase the area available for groundwater recharge by a small amount. The area to be excavated is likely already saturated by river water, but widening the inundated area should widen the saturation area. Currently, the project site is inundated only during extremely large flooding events, but the removal of over 60,000 cubic yards of material from the bank will create 0.4 acres of shallow inundated habitat during the average summer river stage and 1.6 acres of inundated habitat during the average winter river stage. Furthermore, a total of 3.3 acres of floodplain habitat will be created through this project, some of which will be inundated frequently during low-flood stage events. This expansion of the floodplain and more frequent inundation may increase percolation of American River surface water into the groundwater aquifer.

## Water Quality Benefits

### Ecological Decomposition of Contaminants

Widening the inundated area at mile 0.5 of the lower American River will increase the area of wetlands and riparian vegetation. These habitats have a well-documented capacity for ecological decomposition and biological uptake of contaminants. Currently, only large flooding events cause the river to overtop its steep banks; however, this project will create 0.4 acres of shallow inundated habitat during the average summer river stage and 1.6 acres of inundated habitat during the average winter river stage. Furthermore, a total of 3.3 acres of floodplain habitat will be created through this project, some of which will be inundated during frequent, low-flood stage events. This increase in permanently inundated areas and increased frequency of inundation for the floodplain will expand the contaminant buffering capacity of these riparian areas and decrease contaminant loading in American River water. No quantitative estimates of the amount of contaminant decomposition are available, but there are expected to be

improvements in water quality in the lower American River, and the important downstream waters, as a result of this project.

## Other Benefits

### **Provide wetland & riparian habitat for species**

This project will create 1,100 feet of new shoreline with shaded riparian aquatic habitat, brush mattresses, and large instream woody debris. The project will also create 0.4 acres of shallow inundated habitat during the average summer river stage and 1.6 acres of inundated habitat during the average winter river stage. An additional 1.1 acres of frequently inundated floodplain habitat will be created for a total of 3.3 acres of restored riparian and wetland habitat. These habitat types are particularly beneficial for the juvenile stages of delta smelt (state endangered, federally threatened), steelhead trout (federally threatened), and the fall/late fall Chinook salmon run (not a special status species, but a popular sport fish). Additional species that could benefit include juvenile green sturgeon (federally threatened), spring run Chinook (state threatened, federally threatened), and winter run Chinook (state endangered, federally endangered).

All of these valuable special status and other species use shallow flooded habitats such as the project would provide for rearing, and grow much more rapidly in these habitats than in open waters. Invertebrates growing in shallow floodplains are rich food for fish, and shallow vegetated areas provide protection from predators such as birds and non-native predatory fish. Other aspects of this project, such as installation of instream woody material and planting of the riparian zone will provide shade for the water vital for fish and will provide habitat for birds and terrestrial wildlife.

The planting plan would provide a thick band of vegetation near the river and a less dense and varied vegetation over the rest of the mitigation site. Flood-tolerant species such as button bush, cottonwood, willows, mulefat, and box elder would be planted at the lower elevation ranges between six and eight feet. White alder, Santa Barbara sedge, and California rose would be added to this mix in the area between elevation eight and 11 feet. Larger species, vines, and herbaceous ground cover would be used in the area between elevation 11 and 16 feet. These would include box elder, cottonwood, sycamore, valley oak, Oregon ash, California rose, California blackberry, wild grape, mulefat, and creeping wildrye. In the highest area, coyote brush, and elderberry would be added to this mix, and California rose, California blackberry, and mulefat would be removed.

### **Improve recreational opportunities**

The site is within a heavily-accessed public recreation area that experiences, on average, 5 million visitor-days of use per year. The *American River Parkway 2006 Financial Needs Study Update* (County of Sacramento Department of Regional Parks *et al.* 2006, page 9) determined that Parkway nature study contributes over \$23 million annually to the local economy. Fishing in the American River results in \$37 million in annual expenditures, a substantial portion of which could be lost without salmon and steelhead fishing. This project will help sustain these uses through improved fish habitat, especially for vulnerable juveniles. For example, fall/late fall Chinook salmon is not a listed special status species, but is a popular sport fish for which both recreational and sport fishing are often curtailed due to scarcity. Improving juvenile survival for these species may help improve available recreational opportunities for

anglers. This improved habitat will provide indirect fishing benefits by increasing the likelihood that fish born in the American River will return as adults. The presence of charismatic fish like Chinook salmon supports nature appreciation on the river and downstream. Boaters on the river will find that the project adds visual interest to the landscape. Migratory birds using the riparian zone may be appreciated by birders throughout the birds' migratory range.

As an illustration of how the potential value of this project compares to its cost, consider that if it enhances or sustains less than 0.3% of the current recreational value estimated for the lower American River (combined at \$60 million, as described above for fishing and nature study alone), then the PV benefits over the 50-year period would outweigh the project's PV costs of \$1.99M.

### **Improve educational opportunities**

Education and interpretation of salmon and steelhead and their lifecycles and ecological roles are provided at the Nimbus fish hatchery, at the Effie Yeaw Nature Center, and along the American River Parkway trails. Increased presence of wild fish will make these interpretive opportunities more meaningful.

### **Distribution of Project Benefits**

The Sacramento Area Flood Control Agency (SAFCA), the County of Sacramento, and the Water Forum are the three agencies cooperating in implementation or cost-sharing for the Aquatic and Riparian Habitat Enhancement in the Lower American River (LAR) at River Mile 0.5R Project; SAFCA is the project sponsor. All water rights holders on the American River stand to benefit from enhanced species resilience that might otherwise lead to water use restrictions. Anglers who visit the American River, lower Sacramento River, and the Pacific Ocean will benefit from enhanced fishing opportunities due to greater juvenile fish survival. Recreational boaters, nature enthusiasts, and bird watchers will benefit from the improved aesthetic and function of the inundated habitat along the lower American River.

### **Project Benefits Timeline Description**

This project will be executed between 2010 and 2014, but the major implementation phases will occur in 2013. Phase 1 of project construction/implementation (elderberry transplanting) will be conducted in January and February 2013 in accordance with the U.S. Fish and Wildlife Service's (USFWS's) Valley Elderberry Longhorn Beetle (VELB) guidelines and requirements established during consultation with USFWS. Phase 2 of project construction/implementation (de-grading and floodplain habitat creation) would occur during July through November of 2013. Most project benefits will be realized in the short term (2-10 years) after native plants get re-established in the project the area, but some of the benefits will enhance over time (e.g., the next 50 years) as the plants mature and the habitat becomes fully established.

### **Potential Adverse Effects from the Project**

There are no significant adverse effects anticipated from this project that would not be mitigated.

### **Omissions, Biases and Uncertainties**

It is well established that improving shallow floodplain habitat will benefit the target species. A Standard Assessment Methodology (SAM) model was run to evaluate the project and it confirmed its benefits.

Nevertheless, in a natural system, some uncertainty always exists such as the ability of the reconstructed wetland habitat to withstand an extreme flood or the exact spatial area of inundated habitat upon project completion. These uncertainties, however, are unlikely to alter the fundamental project benefits significantly.

## References

County of Sacramento Department of Regional Parks and The Dangermond Group. 2006. *American River Parkway 2006 Financial Needs Study Update*. August 10, 2000, updated June 2006.

## Project 13: Lower Cosumnes River Floodplain Restoration Project

### Summary

The Lower Cosumnes River Floodplain Restoration Project will physically alter the Cosumnes River Preserve Cougar Wetlands Unit to restore historic floodplain connectivity to the lower portions of the river. The project will include levee breaching, interior floodplain de-leveling, installing fish exclusion screens on existing water intake structures, and providing improved freshwater tidal areas and riparian forest habitat for fall run Chinook salmon, Steelhead trout, giant garter snakes, and other species along the lower end of the Cosumnes River. The Cosumnes River Preserve Cougar Wetlands Unit is located approximately 2.5 miles upstream from its confluence with the Mokelumne River.

### Summary of Costs and Benefits

The majority of the project budget (approximately 60%) is for project construction/implementation, but a portion of the budget is required for planning and environmental permitting (22%), in addition to smaller amounts for direct project administration, a project contingency, environmental compliance, and construction administration. Project costs will be spread out over an implementation period between June of 2011 and December of 2013. An additional \$10,000 per year for five years will be required for operations and maintenance for vegetation management to control invasive species and ensure the establishment of desirable riparian forest species, and an additional \$10,000 per year for ten years is required for biological and water quality monitoring.

A summary of the benefits and costs for the project is provided in Table 36. Total present value costs for this project are \$1,049,639 and are illustrated in Table 37.

Using a 50 year project life, Chinook salmon numbers would need to increase by 68 (an increase of under 7% over current salmon levels) – and no other benefits need occur – for this project to have a discounted benefit of \$1,055,023, which would more than cover the present value costs.

**Table 36: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$1,049,639
<u>Monetized Benefits</u>	
Increased Salmon Population	\$1,055,023
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Groundwater Recharge	+
Water Quality Benefits	
Ecological Decomposition of Contaminants	+
Other Benefits	
Provide Wetland & Riparian Habitat for Species	++
Greenhouse Gas Sequestration	12,700 tons
Improved Recreational Opportunities	+
Improved Educational Opportunities	+
Flood Control Benefits	
Flood Damage Reduction	+
<p>O&amp;M = Operations and Maintenance</p> <p>* Direction and magnitude of effect on net benefits:</p> <p>+ = Likely to increase net benefits relative to quantified estimates.</p> <p>++ = Likely to increase net benefits significantly.</p> <p>– = Likely to decrease benefits.</p> <p>– – = Likely to decrease net benefits significantly.</p> <p>U = Uncertain, could be + or –.</p>	

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 37: Annual Cost of Project**  
(All costs in 2009 Dollars)  
**Project: Lower Cosumnes River Floodplain Restoration**

	Initial Costs	Operations and Maintenance Costs <sup>(1)</sup>						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	\$0						\$0	1.000	\$0
2010	\$0						\$0	0.943	\$0
2011	\$255,832		\$5,000	\$5,000		\$10,000	\$275,832	0.890	\$245,490
2012	\$723,004		\$5,000	\$5,000		\$10,000	\$743,004	0.840	\$623,841
2013	\$133,478		\$5,000	\$5,000		\$10,000	\$153,478	0.792	\$121,569
2014	\$0		\$5,000	\$5,000		\$10,000	\$20,000	0.747	\$14,945
2015	\$0		\$5,000	\$5,000		\$10,000	\$20,000	0.705	\$14,099
2016	\$0		\$0	\$0		\$10,000	\$10,000	0.665	\$6,651
2017	\$0		\$0	\$0		\$10,000	\$10,000	0.627	\$6,274
2018	\$0		\$0	\$0		\$10,000	\$10,000	0.592	\$5,919
2019	\$0		\$0	\$0		\$10,000	\$10,000	0.558	\$5,584
2020	\$0		\$0	\$0		\$10,000	\$10,000	0.527	\$5,268
Total	50 years								
<b>Total Present Value of Discounted Costs (Sum of Column (i))</b>									<b>\$1,049,639</b>

Comments: \$5,000 for operations and \$5,000 for maintenance will be needed in each of years 2011 through 2015. These costs will be for vegetation management. While there will be no long term maintenance needs for the site, approximately 5 years are needed to control invasive species and ensure establishment of desirable riparian forest species. Other costs are \$10,000 per year for ten years for biological and water quality monitoring. Project life is listed as 50 years, but could extend considerably longer.

## The “Without Project” Baseline

Without the Lower Cosumnes River Floodplain Restoration Project, the Cougar Wetlands Unit will continue to be managed as a seasonal wetland, filled with pumped river water from an existing agricultural diversion on the Cosumnes River. The site is currently managed for wintering waterfowl use through such pumping in the late fall through early spring, with an estimated several thousand waterfowl using the site annually. The project site only floods during high river flows that over-top the existing levee and inundate the site for extended periods. Flood waters can only recede through a small discharge pipe at the downstream corner of the project site. As flood waters recede, the site traps a small pool of water that strands an estimated 32 species of fish (Moyle *et al.* 2007).

The Cosumnes River is typical of other mid-Central Valley rivers with a degraded channel lacking complexity and few connections to side channels, backwaters, or low elevation floodplains. This condition creates a tendency for juvenile Chinook salmon to be forced downstream during high flow events, without an opportunity to rear in slack water areas, such as floodplains. The project site would remain disconnected from the main river channel without this project, preventing the restoration of historic floodplain connectivity with the river and the ecosystem benefits associated with low flow inundation. These low flow inundations are the most important for ecosystem values because of nutrient cycling, invertebrate production, fish habitat, and overall floodplain productivity. Without the project, 143 acres of riparian forest floodplain would not be restored, and habitat improvements would not be made for special status species, including fall run Chinook salmon, Steelhead trout, and giant garter snakes.

## Water Supply Benefits

### Groundwater Recharge

Creating an active floodplain at mile 2.5 of the Cosumnes River should increase the area available for groundwater recharge by a small amount. Groundwater in the basin underlying the Cosumnes River is overdrafted to such an extent that the groundwater table has effectively separated from the baseflow of the river. By restoring approximately 143 acres of riparian floodplain forest, benefits could accrue to groundwater recharge. This area is currently inundated in the late fall and winter to provide wintering waterfowl habitat, but this project should lead to more frequent inundation of the floodplain from flow flood stage events during the rest of the year when only high flood stage events can overtop the levees and inundate the historic floodplain. This temporal expansion of the floodplain and more frequent inundation may increase percolation of Cosumnes River surface water into the groundwater aquifer. The level of additional groundwater recharge is uncertain (and, as such, is presented here rather than in a stand-alone discussion in an Attachment 7).

## Water Quality Benefits

### Ecological Decomposition of Contaminants

Increasing inundation, especially for low flow events at mile 2.5 of the Cosumnes River should increase the area of wetlands and riparian forest vegetation significantly. These habitats have a well-documented

capacity for ecological decomposition and biological uptake of contaminants. Currently, only large flooding events cause the river to overtop the levees and spill over into the Cougar Wetlands Unit; however, this project will create 143 acres of shallow riparian forest habitat which will be inundated during frequent, low-flood stage events. This significant increase in permanently inundated areas and increased frequency of inundation for the floodplain will expand the contaminant buffering capacity of these riparian areas and decrease contaminant loading in Cosumnes River water. This area can also slow river flows and allow sediment to deposit out of the river flow, especially in the slow moving backwaters of the restored wetlands and riparian areas. No quantitative estimates of the amount of contaminant decomposition or sediment deposition is available, but there are expected to be improvements in water quality in the lower Cosumnes and Mokelumne Rivers as a result of this project. The Cosumnes River is on the 303d list as impaired for *E. Coli*, sediment toxicity, and invasive species. This project will directly address sediment toxicity.

## Other Benefits

### **Provide wetland & riparian habitat for species**

The project will result in the restoration of 143 acres of floodplain riparian habitat. By breaching the levee and de-leveling the floodplain, this project reconnects the river to its historic floodplain, restoring the hydrologic function of the site to facilitate the growth of planted and naturally colonizing riparian vegetation. The restored project site will allow low-flow floods to inundate the floodplain at shallow depths, which is important for ecosystem values because of nutrient cycling, invertebrate production, fish habitat, and overall floodplain productivity. Floodwaters begin the nutrient cycling and decomposition that frees nutrients into the floodplain, stimulating invertebrate production, and providing a rich food source for fish. Approximately 500 native valley oak trees will be established as part of this project to enhance the riparian vegetation regime. Native grass and sedges found on floodplains will be established throughout the entire project area.

The lower portion of the Cosumnes River is tidally influenced to a point just upstream of the project location, making it ideal to provide perennial, off-channel habitat for multiple special status species, including Steelhead trout (federally threatened), giant garter snake (federally threatened), fall run Chinook salmon (federal species of concern), western pond turtle (federal species of concern), valley longhorn elderberry beetle (federally threatened), and Swainson's hawk (state threatened). All these special status species use shallow flooded habitats or riparian forests such as the project would provide.

The habitat created by this project would be especially valuable for rearing juvenile fish, which grow much more rapidly in these habitats than in open waters. Invertebrates growing in shallow floodplains are rich food for fish, and shallow vegetated areas provide protection from predators, such as birds and non-native predatory fish. Steelhead are not regularly recorded on the Cosumnes River, but they are found in the Mokelumne River, a mere 2.5 miles downstream. Due to this proximity, it is projected that Steelhead will use the project site. Giant garter snakes are not found on the project site or in the vicinity, but the project will restore potentially suitable foraging habitat for this federally threatened species. The Cosumnes River historically supported tens of thousands of fall-run Chinook salmon. However, the 2002 salmon run numbered only 1,000. The additional habitat created by this project will especially benefit

juvenile fish and should lead to greater survival rates and greater numbers of returning adults. Additional species of fish, birds, and mammals will use the project site.

Riparian forest are the ecotone between aquatic and terrestrial ecosystems. They facilitate the interaction of dissolved oxygen, nutrients, particulate matter, and organism between the two ecosystems. It is estimated that by the late 1980s, less than 5% of the Sacramento Valley's original riparian forest remained. Although California has lost nearly 95% of its historic riparian forest, the Cosumnes River Preserve protects some of the last remaining old-growth gallery riparian forest in the Central Valley. This project will focus on restoration of this habitat type. The benefits provided by this ecosystem restoration meet several objectives of the CALFED Bay-Delta Program. For example, recovery of salmonid stocks, in general, will improve recreational/commercial fishing opportunities in the Delta, Bay and coastal California and nutrient cycling will improve downstream health of the Delta ecosystem.

There are currently no studies to provide exactly the information that is needed for making management decisions based on monetized benefit values per fish. Various studies of willingness to pay by residents, travel cost surveys, and options values can be used to develop economic valuation estimates. While existing studies often have limitations, they do provide reference points for comparison.

For example, in the 1990 University of California Press publication, *The Struggle to Restore an Imperiled Resource* (Lufkin, 1990), Alan Lufkin surveys the literature to develop a salmonid value range based on all valuation techniques. Lufkin found that the sport fishing nonmarket economic value (in 1990 dollars) of \$675 per California Salmon or Steelhead in the Sacramento/San Joaquin watershed provided what he deemed to be a fair representation of the value to California residents for each Chinook or Steelhead in this region. This amounts to \$1,107 in 2009 dollars, based on the Consumer Price Index. Lufkin states, "Although the economic evaluation of California salmonids should not be expected to produce a complete accounting of the values Californians associate with these fishes, dollar value estimates nonetheless play an important role in determining salmon and Steelhead futures."

It is unclear how much this project alone will restore Chinook numbers in the Cosumnes River. However, we can use this valuation to identify the increase in the number of fish that would need to occur for this project to create benefits equal to costs. Using a 50 year project life, Chinook salmon numbers would need to increase by 68 – and no other benefits need occur – for this project to have a discounted benefit of \$1,055,023, which would more than cover the present value costs. This example calculation is illustrated in Table 38. This reflects about a 7% increase in salmon numbers in the Cosumnes River, compared to the 2002 census.

Similar calculations performed for changes in Steelhead populations would illustrate the great benefit of increasing Steelhead populations. However, due to a lack of population data, no effort was made to monetize this benefit.

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**

(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e)-(d)	Unit \$ Value	Annual \$ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2009	Carbon Sequestration	tons of CO2	0	0	0	\$0	\$0	1.000	\$0
2009	Increased Salmon	number	1000	1000	0	\$1,107	\$0	1.000	\$0
2010	Carbon Sequestration	tons of CO2	0	0	0	\$0	\$0	0.943	\$0
2010	Increased Salmon	number	1000	1000	0	\$1,107	\$0	0.943	\$0
2011	Carbon Sequestration	tons of CO2	0	0	0	\$0	\$0	0.890	\$0
2011	Increased Salmon	number	1000	1000	0	\$1,107	\$0	0.890	\$0
2012	Carbon Sequestration	tons of CO2	0	350	350	\$0	\$0	0.840	\$0
2012	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.840	\$63,232
2013	Carbon Sequestration	tons of CO2	0	350	350	\$0	\$0	0.792	\$0
2013	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.792	\$59,619
2014	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.747	\$0
2014	Increased	number	1000	1068	68	\$1,107	\$75,276	0.747	\$56,231

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**  
(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e)-(d)	Unit \$ Value	Annual \$ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Salmon								
2015	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.705	\$0
2015	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.705	\$53,070
2016	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.665	\$0
2016	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.665	\$50,059
2017	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.627	\$0
2017	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.627	\$47,198
2018	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.592	\$0
2018	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.592	\$44,563
2019	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.558	\$0
2019	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.558	\$42,004
2020	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.527	\$0

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**

(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e)-(d)	Unit \$ Value	Annual \$ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2020	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.527	\$39,670
2021	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.497	\$0
2021	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.497	\$37,412
2022	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.469	\$0
2022	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.469	\$35,304
2023	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.442	\$0
2023	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.442	\$33,272
2024	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.417	\$0
2024	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.417	\$31,390
2025	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.394	\$0
2025	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.394	\$29,659
2026	Carbon	tons of	0	250	250	\$0	\$0	0.371	\$0

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**  
(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e)-(d)	Unit \$ Value	Annual \$ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Sequestration	CO2							
<b>2026</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.371	\$27,927
<b>2027</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.350	\$0
<b>2027</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.350	\$26,347
<b>2028</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.331	\$0
<b>2028</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.331	\$24,916
<b>2029</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.312	\$0
<b>2029</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.312	\$23,486
<b>2030</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.294	\$0
<b>2030</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.294	\$22,131
<b>2031</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.278	\$0
<b>2031</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.278	\$20,927

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**

(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
<b>YEAR</b>	<b>Type of Benefit</b>	<b>Measure of Benefit (units)</b>	<b>Without Project</b>	<b>With Project</b>	<b>Change Resulting from Project (e)-(d)</b>	<b>Unit \$ Value</b>	<b>Annual \$ Value (f) x (g)</b>	<b>Discount Factor</b>	<b>Discounted Benefits (h) x (i)</b>
<b>2032</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.262	\$0
<b>2032</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.262	\$19,722
<b>2033</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.247	\$0
<b>2033</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.247	\$18,593
<b>2034</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.233	\$0
<b>2034</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.233	\$17,539
<b>2035</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.220	\$0
<b>2035</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.220	\$16,561
<b>2036</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.207	\$0
<b>2036</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.207	\$15,582
<b>2037</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.196	\$0
<b>2037</b>	Increased	number	1000	1068	68	\$1,107	\$75,276	0.196	\$14,754

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**  
(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e)-(d)	Unit \$ Value	Annual \$ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Salmon								
2038	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.185	\$0
2038	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.185	\$13,926
2039	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.174	\$0
2039	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.174	\$13,098
2040	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.164	\$0
2040	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.164	\$12,345
2041	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.155	\$0
2041	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.155	\$11,668
2042	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.146	\$0
2042	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.146	\$10,990
2043	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.138	\$0

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**

(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e)-(d)	Unit \$ Value	Annual \$ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2043	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.138	\$10,388
2044	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.130	\$0
2044	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.130	\$9,786
2045	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.123	\$0
2045	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.123	\$9,259
2046	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.116	\$0
2046	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.116	\$8,732
2047	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.109	\$0
2047	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.109	\$8,205
2048	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.103	\$0
2048	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.103	\$7,753
2049	Carbon	tons of	0	250	250	\$0	\$0	0.097	\$0

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**

(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e)-(d)	Unit \$ Value	Annual \$ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Sequestration	CO2							
<b>2049</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.097	\$7,302
<b>2050</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.092	\$0
<b>2050</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.092	\$6,925
<b>2051</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.087	\$0
<b>2051</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.087	\$6,549
<b>2052</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.082	\$0
<b>2052</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.082	\$6,173
<b>2053</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.077	\$0
<b>2053</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.077	\$5,796
<b>2054</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.073	\$0
<b>2054</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.073	\$5,495

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**

(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
<b>YEAR</b>	<b>Type of Benefit</b>	<b>Measure of Benefit (units)</b>	<b>Without Project</b>	<b>With Project</b>	<b>Change Resulting from Project (e)-(d)</b>	<b>Unit \$ Value</b>	<b>Annual \$ Value (f) x (g)</b>	<b>Discount Factor</b>	<b>Discounted Benefits (h) x (i)</b>
<b>2055</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.069	\$0
<b>2055</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.069	\$5,194
<b>2056</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.065	\$0
<b>2056</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.065	\$4,893
<b>2057</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.058	\$0
<b>2057</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.058	\$4,366
<b>2058</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.054	\$0
<b>2058</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.054	\$4,087
<b>2059</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.051	\$0
<b>2059</b>	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.051	\$3,855
<b>2060</b>	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.048	\$0
<b>2060</b>	Increased	number	1000	1068	68	\$1,107	\$75,276	0.048	\$3,637

American River Basin  
Attachment 8 – Water Quality & Other Expected Benefits

**Table 38: Water Quality and Other Expected Benefits**  
(All benefits in 2009 Dollars)

**Project: Lower Cosumnes River Floodplain Restoration Project**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
YEAR	Type of Benefit	Measure of Benefit (units)	Without Project	With Project	Change Resulting from Project (e)-(d)	Unit \$ Value	Annual \$ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Salmon								
2061	Carbon Sequestration	tons of CO2	0	250	250	\$0	\$0	0.046	\$0
2061	Increased Salmon	number	1000	1068	68	\$1,107	\$75,276	0.046	\$3,431
Project Life	CO2				12700 tons CO2; 3,400 salmon			...	<b>\$1,055,023</b>
<b>Total Present Value of Discounted Costs (Sum of Column (i))</b>									<b>\$1,055,023</b>
Comments: Carbon sequestration benefits were calculated by assuming average values from available estimates for perennial grasses and riparian oak forests. The 143 acres of restored perennial grasses and sedges will sequester approximately 200 tons of CO2, split between the first two years of restoration as these habitats develop quickly. The 143 acres of riparian oak forests will yield 250 tons of CO2 sequestered annually. For the increase in salmon, this analysis does not specify an actual estimate of projected salmon increases. Instead, this analysis determines how much population increase in salmon would be needed for this project to create net present benefits equal to net present costs.									

### **Greenhouse gas sequestration**

This project would result in the sequestration of carbon dioxide, a greenhouse gas that leads to global warming. By revegetating a currently seasonally inundated area with riparian forest, carbon dioxide will be removed from the atmosphere as trees and native grasses are replanted and grow, incorporating atmospheric CO<sub>2</sub> into biomass. For this benefit to last, the vegetation must grow in perpetuity or the wood from them must itself be sequestered to prevent burning or rotting from re-releasing the CO<sub>2</sub> when the vegetation dies. Sequestration is substantially higher during the early growth years and levels about as plants mature. Forests annually sequester between 1.0 and 2.5 tons of CO<sub>2</sub> per acre depending upon vegetation type and climate while perennial grasses will sequester between 0.3 to 2.5 tons per acre, but do not continue to sequester carbon annually (Earsom *et al.* 2008). Assuming average values from these estimates, the 143 acres of restored perennial grasses and sedges will sequester approximately 200 tons of CO<sub>2</sub> and the 143 acres of riparian oak forests will yield 250 tons of CO<sub>2</sub> sequestered annually. Assuming a 50 year life for the habitat restoration, this project will sequester a total of 12,700 tons CO<sub>2</sub> over the project life. This benefit is quantified by year in Table 38, but not assigned a monetary value.

### **Improve recreational opportunities**

The Cougar Wetlands Unit is the only area of the Cosumnes River Preserve that allows waterfowl hunting. However, this activity is restricted to allow and encourage only youth, women, and handicapped hunters on a limited entry/reservation basis. Approximately 200 hunters use the site annually, and this number is expected remain the same. The improvements made by this project should improve the hunting experience by increasing the esthetic of the hunting area and enhancing habitat values that are likely to bring more waterfowl to the site. Furthermore, facilities such as access routes and hunting blinds will be improved with this project.

Fishing in the Cosumnes and Mokelumne Rivers is an important recreational activity primarily focused on salmon and Steelhead fishing. This project will help sustain these uses through improved fish habitat, especially for vulnerable juveniles. Both fall-run Chinook salmon and Steelhead are popular sport fish for whom both recreational and sport fishing are often curtailed due to scarcity. Improving juvenile survival for these species may help improve available recreational opportunities for anglers. Additionally, this improved habitat will provide indirect fishing benefits by increasing the likelihood that fish born in the Cosumnes River will return as adults. The presence of charismatic fish like Chinook salmon supports nature appreciation on the river and downstream. Migratory birds using the riparian zone may be appreciated by birders throughout the birds' migratory range. The 500 feet of Americans with Disability Act (ADA) accessible paths on the project site allow all of these recreational benefits to be appreciated by the mobility impaired.

### **Improve educational opportunities**

The Cosumnes River Preserve is visited by over 10,000 school children annually. The restoration project will include educational and volunteering opportunities for youths and other Preserve visitors. The ecological education opportunities through this accessible site will improve dramatically as the floodplain restoration project unfolds, providing a hands-on interpretive opportunity for ecological restoration.

## Flood Control Benefits

### Flood damage reduction

This project will increase the floodplain's holding capacity, attenuating flood peak, reducing water velocity, and thereby decreasing the risk of flooding to surrounding areas. No hydrologic modeling has been performed to confirm this benefit (hence this benefit is described here qualitatively rather than in Attachment 9). Nonetheless, this project is expected to ameliorate the impacts from low flood stage events by reconnecting the river to its historic floodplain.

## Distribution of Project Benefits

The project currently has multiple partners including Ducks Unlimited, Bureau of Land Management, The Nature Conservancy, California Department of Fish and Game, and the U.S. Fish and Wildlife Service. Ducks Unlimited will manage the project and be responsible for coordinating environmental permits, engineering design, construction management, and all contract administration. Ducks Unlimited will assist with funding acquisition and finance development. The Bureau of Land Management will be the lead Federal agency for NEPA and NHPA, and will assist with project funding. The U.S. Fish and Wildlife Service will assist with NEPA and funding. The Nature Conservancy is an adjoining landowner and will assist with project planning and implementation. The California Department of Fish and Game is a partner on the Cosumnes River Preserve and will assist with development of the Streambed Alteration 1600 agreement.

Anglers who visit the Cosumnes River, Mokelumne River, and the Delta will benefit from enhanced fishing opportunities due to greater juvenile fish survival. Nature enthusiasts and bird watchers will benefit from the improved aesthetic and function of the inundated habitat. And handicapped hunters, as well as youth and women, will benefit from an enhanced habitat for waterfowl hunting. Over 10,000 school children will benefit from the interpretive and education opportunities provided by the ecosystem restoration project. All water rights holders on the Cosumnes River stand to benefit from enhanced species resilience that might otherwise lead to water use restrictions.

**Table 39: Project Beneficiaries Summary**

Local	Regional	Statewide
Ducks Unlimited, BLM, TNC, anglers, nature enthusiasts, hunters, school children, Cosumnes River water rights holders	California Department of Fish and Game, neighboring communities, stakeholders on the Mokelumne River	Stakeholders in the Delta

## Project Benefits Timeline Description

This project will be executed between June 2011 and December 2013. The conceptual design has already been completed. Environmental permitting and further design work will take up the remainder of 2011 and part of 2012. Solicitation for construction will occur in June 2012. Construction implementation will occur in the second half of 2012 and throughout 2013, starting with levee breaching and de-leveling

followed by native riparian species planting. Weed management will be needed to control invasive species and ensure the establishment of desirable riparian forest species for an estimated five years. Most project benefits will be realized in the short term (2-10 years) after native plants get re-established in the project the area, but some of the benefits will enhance over time (e.g., the next 50 years) as the plants mature and the habitat becomes fully established.

### Potential Adverse Effects from the Project

There are no adverse effects anticipated from this project.

### Omissions, Biases and Uncertainties

It is well established that improving shallow floodplain habitat will benefit the target species. Most of the benefits are virtually certain to occur because the relevant species are already present and providing additional habitat and restoring the natural hydrology to the floodplain will inexorably lead to the cited benefits due to natural processes that are well understood. Nevertheless, in a natural system, some uncertainty always exists such as the ability of the reconstructed wetland habitat to withstand an extreme flood or the exact spatial area of inundated habitat upon project completion. These uncertainties, however, are unlikely to alter the fundamental project benefits significantly. There are uncertainties associated with calculating the carbon sequestration benefits. These are described in the table below.

**Table 40: Omissions, Biases, and Uncertainties, and Their Effect on the Project**

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Exact carbon sequestration by habitat type	U	Sequestration by the specific habitat types for this project could be slightly higher or slightly lower than those cited for “forests” and “grasslands” above.
Change in sequestration over time	U	While biomass generally sequesters more CO <sub>2</sub> during early development and less as the plants mature, we averaged these effects out over the lifetime of the project
Disposition of biomass	U	While a forest fire or degradation of the habitat could theoretically lead to the CO <sub>2</sub> being re-released into the environment, this project appears unlikely to lead to a net increase in CO <sub>2</sub> , and CO <sub>2</sub> sequestration benefits are likely to enhance as the habitat matures
Project lifetime	+	We assumed a 50 year lifetime for the sequestration benefits associated with this project. However, oaks are slow maturing trees and may provide benefits over a longer timeframe
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

## References

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## Project 14: OHWD / Rancho Murieta Groundwater Recharge Project

### Summary

The OHWD/Rancho Murieta Groundwater Recharge Project is a regional conjunctive use project that will divert 4,000 acre-feet per year (AFY) of available water owned by Rancho Murieta Community Services District (RMCS D) to spreading basins in the Omocho mne-Hartnell Water District (OHWD) service area to allow recharge of the groundwater aquifer. This project will benefit RMCS D by allowing the recovery of some of the stored water during dry years to meet water supply shortages, while also benefiting OHWD by increasing groundwater levels in the aquifer that is utilized by land owners in the OHWD service area. The project may also enhance regional salmon migration, as the project will assist in the reconnection of the groundwater with the Cosumnes River baseflow; this connection is necessary to establish and maintain Fall river flows for salmon migration.

Currently, RMCS D's only water supply is a surface water diversion from the Cosumnes River during November through May. Water is currently stored in three surface water reservoirs for year-round use. The benefits conveyed by the proposed project are two-fold: first, the project will supply water in years when the river flows do not allow full diversions, providing a reliable water supply; and second, the project expands supply options should there be a catastrophic failure at the water plant (e.g., due to wildfire) or if reservoir supplies become contaminated.

### Cost and Benefit Summary

A summary of all benefits and costs for this project are provided in Table 41. Discounted project costs over the 40 year life of the project are about \$2.53 million. Monetized project benefits include an avoided present value water supply benefit of about \$3.43 million. Additional significant qualitative benefits include: water supply flexibility and conjunctive uses, increases in available water for well users and benefits to the salmonid fisheries.

Water Quality and other benefits are discussed in the remainder of this attachment. Costs and Water Supply Benefits are discussed in Attachment 7.

**Table 41: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$2.53 million
<u>Monetized Benefits</u>	
Water Supply Benefits	
Avoided cost of construction of recycled water infrastructure	\$3.43 million
Total Monetized Benefits	\$3.43 million
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Improved operational flexibility in case of catastrophic event	++
Increased supply reliability to local well users	++
Water Quality and Other Benefits	
Increased Salmon fisheries	++
O&M = Operations and Maintenance	
* Direction and magnitude of effect on net benefits:	
+ = Likely to increase net benefits relative to quantified estimates.	
++ = Likely to increase net benefits significantly.	
– = Likely to decrease benefits.	
-- = Likely to decrease net benefits significantly.	
U = Uncertain, could be + or –.	

## The “Without Project” Baseline

Without this project, unused water allocations during wet years will not be stored for use during dry years and in the event of a catastrophe (e.g. earthquake, terrorism, reservoir contamination); no backup water supply option will be available.

The 2010 Master Plan for RMCSO identified a water supply shortfall during times of drought. Three options were identified to increase supplies to meet this potential shortfall; groundwater recharge of excess supply during wet years was identified as the most cost-effective. The other two options – development of a recycled water infrastructure or the purchase and construction of an additional reservoir -- are significantly more expensive. Without this project, RMCSO will be forced to either expand recycled water service, with a cost of \$5 million to \$15 million in infrastructure, or purchase additional surface water storage, with an associated cost of \$15 million.

## Water Quality and Other Benefits

### Restoration of Salmon Migration & Spawning Habitat

The primary water quality and other benefit associated with this project is the potential for the rise in groundwater levels to provide in-stream flows during the seasonal dry times (early fall) in the Cosumnes

River. This would allow for the return of historical salmonid migration and spawning activities to occur in the Cosumnes River.

The Anadromous Fish Restoration Program (AFRP), The Nature Conservancy (TNC), and the University of California, Davis (UCD) have sponsored numerous research projects on the health of the salmon fishery of the Cosumnes River. AFRP has also identified the Cosumnes River as having potential for contributing to the fish doubling goals of the Central Valley Project Improvement Act (CVPIA). The AFRP has also set program objectives specifically directed at the Cosumnes River and the acquisition and restoration of fish habitat, primarily directed at improving passage and spawning habitat for fall-run Chinook salmon.

Dr. Fogg (Professor at the University of California Davis) and graduate student Jan Fleckenstein conducted a study that determined that, although the river often has some dry sections in summer, a half-century of groundwater pumping within the Cosumnes watershed was making those dry sections bigger (up to 20 miles long) and longer lasting. As a result, the scientists found that fall-run Chinook salmon could not travel upstream to spawn and young trees in the riparian forest could not survive.

This project is expected to contribute to the reconnection of the Cosumnes River baseflow with the local aquifer- providing stream flows during the dry season when salmonid fisheries migrate and spawn.

### Distribution of Project Benefits

Salmonid migration and spawning benefit accrues to locals and well as regional fisheries and habitat goals, and meets statewide goals for salmon restoration and protection. Beneficiaries are summarized in Table 42.

**Table 42: Project Beneficiaries Summary**

Local	Regional	Statewide
Salmonid fisheries	Salmonid fisheries	Salmonid fisheries

### Project Benefits Timeline Description

Project benefits are expected to continue for the lifespan of the project – 40 years, and beyond.

### Potential Adverse Effects from the Project

There are no potential adverse effects associated with this project.

### Summary of Findings, Tables

The primary water quality and other benefit associated with this project is the potential for the rise in groundwater levels to provide in-stream flows during the seasonal dry times to enable the historical return of salmonid migration and spawning activities to occur in the Cosumnes River.

**Table 43: Qualitative Benefits Summary – Water Quality and Other Benefits**

Benefit	Qualitative Indicator
Salmonid Fisheries Restoration	++

### Omissions, Biases and Uncertainties

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, extent to which this project contributes to groundwater recharge. This issue is addressed in Table 44.

**Table 44: Omissions, Biases, and Uncertainties, and Their Effect on the Project**

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Salmonoid Fisheries Restoration	U	It is unknown if the quantity of groundwater recharge associated with this project is adequate to provide the reconnection to the aquifer necessary for the Cosumnes River to have in-stream flows during the dry season.
*Direction and magnitude of effect on net benefits: + = Likely to increase net benefits relative to quantified estimates. ++ = Likely to increase net benefits significantly. - = Likely to decrease benefits. -- = Likely to decrease net benefits significantly. U = Uncertain, could be + or -.		

## Project 15: Sleepy Hollow Detention Basin Retrofit Project

### Summary

The Sleepy Hollow Detention Basin Retrofit Project will transform the existing 6.3-acre Sleepy Hollow Detention Basin into a multi-functional water resource feature. In addition to providing flood control, the upgraded basin will recharge the groundwater aquifer, reduce stormwater runoff into Laguna Creek, provide important habitat for birds and aquatic species, and serve as a recreational and educational space during non-flood periods.

Key components of the project include the planting of native vegetation within and around the basin to increase and improve aquatic and upland habitat and to enhance water quality treatment capabilities. Darcy Columns (dry wells) will also be evaluated for promoting the infiltration and percolation of stormwater into the underlying groundwater basin for basin recharge. This water can be recovered later as needed by local well users. Additionally, the project would add trails to provide recreational/aesthetic opportunities to the local community during non-flood and low-flow periods. And finally, with the natural

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resource and access improvements, the basin can become an ‘outdoor classroom’ for the five schools located within a two-mile radius of the project site and for the community.

The City of Elk Grove will serve as the lead implementation agency; however, this project will be implemented in coordination with the Laguna Creek Watershed Council (LCWC) and the Sheldon Community Association.

A summary of all benefits and costs of the project are provided in Table 45. Project costs and water supply benefits are discussed in the remainder of this attachment.

**Table 45: Benefit-Cost Analysis Overview**

	Present Value
<u>Costs</u> – Total Capital and O&M	\$837,742
<u>Monetized Benefits</u>	
Water Supply Benefits	
Water conservation for disadvantaged customers	\$106,144
Total Monetized Benefits	\$106,144
<u>Qualitative Benefit or Cost</u>	Qualitative indicator*
Water Supply Benefits	
Improved Water Supply Reliability	+
Water Quality and Other Benefits	
Improved surface water quality in Laguna Creek tributary	++
Improved upland habitat	++
Increased aesthetics, recreational and educational opportunities	++
Additional flood control benefits	+
O&M = Operations and Maintenance	
* Direction and magnitude of effect on net benefits:	
+ = Likely to increase net benefits relative to quantified estimates.	
++ = Likely to increase net benefits significantly.	
– = Likely to decrease benefits.	
– – = Likely to decrease net benefits significantly.	
U = Uncertain, could be + or –.	

### The “Without Project” Baseline

The Sleepy Hollow Detention Basin is located adjacent to the Sleepy Hollow Subdivision in the City of Elk Grove. Elk Grove is located within the Laguna Creek Watershed, which encompasses approximately 65 square miles of land draining to Laguna Creek and its tributary streams. Starting in northeast Sacramento County, Laguna Creek flows southwesterly through Elk Grove to its confluence with

Morrison Creek. Downstream of the Morrison Creek confluence, water is either pumped to the Sacramento River, or during winter storms, may travel to the Beach Lake-Stone Lake system (Stone Lakes National Wildlife Refuge) before it ultimately discharges into the Sacramento River within the Sacramento-San Joaquin Delta (Delta) region.

Elk Grove mostly falls within the lower portion of the Laguna Creek watershed area, which is characterized by large urbanized/suburbanized areas with residential and commercial development. There are several main tributaries that drain into Laguna Creek in the lower watershed including: Sun Creek, Frye Creek, Toad Creek, Sheldon Creek, Elk Grove Creek, Whitehouse Creek, and Jacinto Creek.

Water quality conditions in the lower watershed reflect the sum of instream and riparian conditions, and of impacts from both the quality and quantity of urban runoff. Water quality constituents commonly found in urban runoff from developed areas of the lower watershed include trash, oil and grease, metals, polycyclic aromatic hydrocarbons (PAHs), bacterial contaminants, inorganic forms of nitrogen and phosphorous, sediment, and pesticides (Laguna Creek Watershed Council, 2009). In the immediate project area, the existing detention basin filters some of these pollutants, however, many are discharged into Laguna Creek tributary.

In addition to water quality constituents found in stormwater runoff, the volume, duration, and frequency of flows from outfalls of stormwater management features (including detention basins) that exceed the erosive potential of the receiving channel's boundary material can cause or lead to the erosion of downstream channel boundaries and to increased channel instability over time. Unstable channel bank and bed conditions can trigger a series of events that result in decreased water quality conditions downstream. A few examples include: weakened or eroded banks leading to the loss of riparian canopy and increased water temperatures; bank erosion leading to channel widening, decreased water depth, increased water temperatures, and increased growth of emergent aquatic vegetation; and eroded bank materials increasing water turbidity (Laguna Creek Watershed Council 2009).

The Laguna Creek watershed provides important aquatic habitat for a diverse group of plant, wildlife, and fish species, including several special-status species. The creek also serves as an important corridor, hydrologically connecting aquatic and upland habitats throughout the watershed. Throughout the different reaches of Laguna Creek, the use of different aquatic habitats by various species is influenced by variations in creek habitat conditions and by the habitat requirements and behavior of each species. Urbanization and the associated altered flow regimes within the watershed have affected available habitat and ecological processes (Laguna Creek Watershed Council 2009).

Without the retrofit project, 50 acre-feet (AF) of stormwater runoff will continue to be discharged to Laguna Creek each year, negatively affecting surface water and riparian and aquatic habitat. In addition, although the basin fulfills its original design intention of stormwater detention, native vegetation is sparse in and around the basin and consequently provides poor habitat for native wildlife. By improving upland habitat through native planting, the Sleepy Hollow Basin Retrofit Project will enhance aquatic and upland habitat and provide recreational, educational, and aesthetic opportunities to the area.

## Water Quality and Other Benefits

The project will provide a range of water quality and other benefits. This section provides a discussion for these benefits, including improved water quality in Laguna Creek tributary and Laguna Creek, improved native upland habitat, increased recreational and educational opportunities, and increased aesthetics.

### Improved Surface Water Quality in Laguna Creek Watershed

As a result of the proposed project, stormwater runoff and floodwaters diverted to the Sleepy Hollow Detention Basin will be used to recharge the groundwater aquifer, rather than being discharged to Laguna Creek tributary. This will result in improved surface water quality due to decreased pollutant loading associated with urban runoff. In addition, the volume, duration, and frequency of flows from associated with discharge from the detention basin during large storm events will be avoided.

The over-application of retail fertilizers, such as those containing diazoin and chloropyrifos, has resulted in increased levels of these compounds in area runoff and surface water, and is a specific concern in the lower watershed. In addition, water quality constituents commonly found in urban runoff include trash, oil and grease, metals, polycyclic aromatic hydrocarbons (PAHs), bacterial contaminants, inorganic forms of nitrogen and phosphorous, sediment, and pesticides. In the immediate project area, the existing detention basin filters some of these pollutants, however, many are discharged into Laguna Creek tributary (Laguna Creek Watershed Council 2009). Increased basin vegetation and basin design modifications resulting from project implementation should improve the filtering capacity of the basin; however, the extent of this improvement is not known.

### Improved Upland Habitat

The improvement of 6.3 acres of upland habitat through native planting and the restoration of a more natural flow regime in Laguna Creek tributary (due to reduced stormwater and flood flows from the current detention basin) will result in significant benefits for native wildlife and habitat.

Laguna Creek and its tributaries provide important aquatic habitat for a diverse group of plant, wildlife, and fish species. The creek also serves as an important corridor, hydrologically connecting aquatic and upland habitats throughout the watershed. Throughout the different reaches of Laguna Creek, the use of different aquatic habitats by various species is influenced by variations in creek habitat conditions and by the habitat requirements and behavior of each species. Urbanization and the associated altered flow regimes within the watershed have affected available habitat and ecological processes.

According to the Laguna Creek Watershed Council (2009), efforts to improve the quality of aquatic and riparian habitats along the banks of Laguna Creek and its tributaries have the potential to benefit 23 special-status plant and wildlife species. In addition, nearly 15 special-status plant and wildlife species depend on high-quality grasslands and vernal pools for their survival, and may benefit from upland habitat preservation and enhancements within the Laguna Creek Watershed.

### Increased Aesthetic, Recreational and Educational Opportunities

The upgraded detention basin will provide a number of public education opportunities. The City plans to coordinate with non-profit organizations, including the Laguna Creek Watershed Council and the

Cosumnes Community Services District, to put educational programs in place. Once completed, the retrofitted basin will serve as a pilot/demonstration project to the Sacramento area and the local communities, demonstrating low impact development (LID) techniques, and will provide ‘outdoor classroom’ opportunities to five schools within a two-mile radius of the project site.

In addition, the planting of native vegetation and new trails installed as part of the project implementation will provide improved aesthetics and recreational opportunities for the local community as compared to existing conditions. While still serving as a detention basin during storm events, the basin would serve as a recreational site during low-flow and no-flow periods.

### **Additional flood control benefits**

In addition to continuing to provide existing flood control benefits, the project will improve the detention basin’s flood attenuation performance as the proposed Darcy (dry) wells will intercept initial stormwater runoff volumes. The desired outcome of intercepting flows will be a reduction of the 100-year water surface elevation in the basin.

### **Distribution of Project Benefits**

The Sleepy Hollow Detention Basin Retrofit Project includes a wide range of beneficiaries. At the local level, Elk Grove residents will benefit from increased aesthetics, educational, and recreational opportunities. The project will provide local, regional, and statewide benefits by improving water quality in Laguna Creek and downstream waterbodies, and by providing native upland habitat. The project will benefit many species of statewide significance.

### **Project Benefits Timeline Description**

The project build-out and capital costs will be incurred in 2011, 2012 and 2013. Project benefits will begin in 2011 and will continue for the expected 25-year lifetime (although the savings value of some components will decrease with time, as reflected in the benefits estimates for those components).

### **Potential Adverse Effects from the Project**

This project is proposing to percolate stormwater into the underlying groundwater basin. Program that directly introduce stormwater into a groundwater basin hold the potential for introducing pollutants found in stormwater into groundwater systems and impacting the basin and users of the basin. However, with appropriate system design and operation (i.e. placing the wells in locations not receiving first-flush water combined with soil-aquifer treatment), the potential for introduction of pollutants can be avoided. This project will utilize soil-aquifer treatment (or SAT) as a means of treating recharging stormwater. In general, the vadose zone, and in some cases the aquifer itself, act as natural, slow filters, reducing the concentration of various pollutants due to physical, chemical, and microbiological processes. Suspended solids are filtered out; biodegradable organic compounds are decomposed; microorganisms are adsorbed, strained out, or die because of competition with other soil microorganisms; nitrogen concentrations are reduced by denitrification; synthetic organic compounds are adsorbed and/or biodegraded; and phosphorous, fluoride, and heavy metals are adsorbed, precipitated, or otherwise immobilized. In

summary, soil-aquifer treatment is a recognized method for treating stormwater for reuse, and along with proper monitoring and institutional controls, the potential impact is marginal and can be managed.

## Summary of Findings

The proposed project will provide a range of both water quality and other benefits including improved water quality in Laguna Creek tributary and downstream waterbodies, improved native habitat, increased aesthetics, educational, and recreational opportunities, and additional flood control benefits. Each of these benefits is expected to increase the overall net monetized benefits of the proposed project, if they could be monetized.

## References

Laguna Creek Watershed Council. 2009. *Laguna Creek Watershed Management Action Plan*.